Folks,

Motor Torpedo Boats, Tactical Orders and Doctrine, July 1942, was created in the early part of the US participation in WW II. The manual provides insight into how PT Boats were used.

In this online version of the manual we have attempted to keep the flavor of the original layout while taking advantage of the Web's universal accessibility. Different browsers and fonts will cause the text to move, but the text will remain roughly where it is in the original manual. We have not attempted to correct any errors found in the original document. However, this text was captured by optical character recognition and then encoded for the Web which has added new errors we wish to correct.

Please report any typos, or particularly annoying layout issues to info@hnsa.org for correction.

We also wish to thank PT Boats Inc. for the loan of this manual so we could scan it and present it on this web site.

Richard Pekelney
Webmaster

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✦

MOTOR TORPEDO BOATS

TACTICAL ORDERS AND DOCTRINE

JULY 1942

HEADQUARTERS OF THE COMMANDER IN CHIEF
UNITED STATES FLEET

MOTOR TORPEDO BOATS

TACTICAL ORDERS AND DOCTRINE

JULY 1942

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CONFIDENTIAL

JULY 1, 1942.

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RUSSELL WILLSON,
Chief of Staff.

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Version 1.02, 10 Apr 06

PT Boats Inc. Archives and Library

PT Boats, Inc. is an organization established by veterans of WW II PT service to preserve the story Patrol Torpedo Boats and the men who manned and supported the "Mosquito Fleet."

Headquarters is in a suburb of Memphis Tennessee where the majority of the organization's photographic collection numbering many thousands are kept. Additionally, manuals, charts, periodicals of the era, some logs and diaries, film and factory blueprints are housed here. Other holdings include memorabilia ranging from a Japanese bugle, to propaganda leaflets and Shellback certificates.

Over one hundred books either mentioning or exclusively about PTs have been collected along with other naval references.

The collection focuses on WW II PT boats in the United States Navy; however, limited information has been accumulated about foreign coastal and patrol craft including a small amount about the Korean and Vietnam-era patrol craft.

Archives are open by appointment for research. Some searches can be done by staff if questions are specific. Copying service is available for 50 cents a page. Large copying orders will have postage added.

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PT Boats, Inc. restored two PT boats to WW II configuration. PTs 796 and 617 may be seen at the organization's museum which is part of Battleship Cove in Fall River, Massachusetts. Both PTs are National Historic Landmarks.

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PART 1. GENERAL DOCTRINE

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CHAPTER 1. GENERAL AND MILITARY CHARACTERISTICS

1101. The motor torpedo boat is a relatively small craft with great speed and striking power essentially offensive in character. Weapons consist of torpedoes, machine guns and usually depth charges. Its main defensive power lies in its small size, speed, maneuverability, ability to lay smoke and cruise silently at slow speeds.

1102. The primary mission of motor torpedo boats is to attack enemy surface ships. Their high speed, and torpedo armaments makes them most suitable for surprise attacks against enemy vessels on the surface, at night or during low visibility.

1103. Secondary functions which motor torpedo boats may be called upon at times to fulfill are listed as follows:

(a) Antisubmarine operations.
(b) Emergency rescue vessels.
(c) Escort duty.
(d) Mine laying.
(e) Commando missions.

It must be borne in mind, however, that constant employment of these vessels for other purposes than for which designed, shortens the life of the boats, thus tending to reduce their effectiveness when called upon to fulfill their primary mission.

1104. To attain maximum effectiveness in motor torpedo boat operations requires a complete understanding of their capabilities. Like aircraft they require experienced and qualified

(1)

operating personnel, adequate base and tender repair facilities, and expert ground and servicing crews.

1105 (a) Success in motor torpedo boat operations requires extreme alertness and intelligence on the part of operating personnel. Surprise, deception, stealth, daring, and courage, are all elements favorable to success.

(b). It should not be necessary to state that the boat's armament **must** be kept ready for instant action on every wartime mission. Enemy contacts will occur after weeks and months of negative operations have tended to dull the appreciation of needs for such readiness. History is replete with instances of golden opportunities being lost through this neglect.

(c). Immediately an enemy is encountered there are two steps to be taken, (1) offensive action, the effectiveness of which depends strongly upon the promptness with which it is executed and (2) report to proper authority the presence of the enemy. In the excitement incident to the former, the latter should not be forgotten, and the ship's organization should provide means for insuring it is not neglected.

1106. Any commander directing motor torpedo boat operations for general or specific tasks, will give consideration to the characteristics and capabilities of the vessels, as noted below.

MILITARY CHARACTERISTICS

1107 (1) PT 20 type-PTs 20-68 (Elco Boatworks). Length 77 feet; beam 20 feet; maximum draft 5 feet; displacement 95,000 pounds.

(*a*) GUNS:

Four .50-caliber air-cooled B. A. machine guns in two twin, hand-operated scarf ring mounts.

One 20-mm. Oerlikon mount. (Not carried by all squadrons.)

One .45-caliber Thompson submachine gun.

One or two Lewis machine guns mounted forward. (Not carried by squadrons having Thompson gun.)

Two .30-caliber Springfield rifles.

Thirteen .45-caliber Colt pistols.

(*b*) AMMUNITION-20-mm.:

Allowance-1,200 rounds.

Carried on board-480 rounds in eight 60-round magazines (ratio one Tr. to one H. E.).

2

.50-caliber:
Allowance-10,000 rounds per gun.
Carried on board-1,000 rounds per gun belted (ratio one Tr. to two A. P.) in four 250-round magazines per gun.

.45-caliber:
Allowance-4,000 rounds ball.
Carried on board-All.

.30-caliber:
Allowance-1,200 rounds.
Carried on board-All.

(*c*) TORPEDOES: Four 21-inch Mark 8-3C and D, speed 27 knots, range 13,500 yards. (If depth charges and 20-mm. gun are mounted, only two 21-inch torpedoes are carried, the other two are held in reserve.)

(*d*) TORPEDO TUBES: Four 21-inch Mark 18-1 bow launching. (Only two tubes mounted if 20-mm. gun and depth charges carried.)

(*e*) DEPTH CHARGES: Eight Mark 6 (300-pound charge).

(*f*) DEPTH CHARGE RACKS: Eight individual side launching type "C", or two (four charge each) stern launching.

(*g*) SMOKE SCREEN GENERATOR: Mark 3, capacity 32-gallon F. S. mixture.

(*h*) FRESH WATER: 180 gallons in two 90-gallon capacity tanks.

(*i*) FUEL: 3,000 gallons high octane gasoline.

(*j*) LUBRICATING OIL: 30 gallons.

(*k*) FRESH PROVISIONS: Four days' rations for nine men and two officers.

(*l*) COMMUNICATIONS: Blinker tube, semaphore, M. P. signal light, 8-inch searchlight, GF5, RU7, or TCS voice radio sets, range about 75 miles.

(*m*) RADIO DIRECTION FINDER: One R. D. F. per division in some squadrons, one R. D. F. per boat in other squadrons.

(*n*) MACHINERY:

Main engines-three 1,200-hp. Packard 4-M2500.
Auxiliary gen.-1 Lawrence 5-kw. generator, air-cooled.
Power-four 6-volt storage batteries 24 volts.
Shafts-three shafts, three propellers (all right-hand).

Rudders-three rudders, mechanical steering.

(*o*) CRUISING RADIUS (see table in back of book):

Full load maximum speed, 41 knots, 259 miles;
Full load maximum sustained speed, 35 knots, 358 miles;
Full load one engine, 11 knots, 1,050 miles.

(2) PT 71 type-PTs 71-94 (Higgins Industries).[1] Length 78 feet; beam feet; maximum draft _____; displacement _____ pounds.

(*a*) GUNS:

Four .50-caliber air-cooled B. A. machine guns in two twin, hand-operated scarf ring mounts.
One 20-mm Oerlikon mount.
One .45-caliber Thompson submachine gun.
Two .30-caliber Springfield rifles.
Thirteen .45-caliber Colt pistols.

(*b*) AMMUNITION-20-mm.:

Allowance-1,200 rounds.
Carried on board-480 rounds in eight 60-round magazines (ratio one Tr. to one H. E.).

.50-caliber:

Allowance-10,000 rounds per gun.
Carried on board-1,000 rounds per gun belted (ratio one Tr. to two A. P.) in four 250-round magazines per gun.

.45-caliber:

Allowance-4,000 rounds ball.
Carried on board-All.

.30-caliber:

Allowance-1,200 rounds.
Carried on board-All.

(*c*) TORPEDOES: Four 21-inch Mark 8-3C and D, speed 27 knots, range 13,500 yards. (If depth charges and 20-mm. gun are mounted, only two 21-inch torpedoes are carried, the other two are held in reserve.)

(*d*) TORPEDO TUBES: Four 21-inch Mark 19 bow launching. (Only two tubes mounted if 20-mm. gun and depth charges are mounted.

(*e*) DEPTH CHARGES: Eight Mark 6 (300-pound charge).

(*f*) DEPTH CHARGE RACKS: Eight individual side launching type "C". -- [1] Complete information not available and blank should be filled in when information is obtained.

(*g*) SMOKE SCREEN GENERATOR: Mark 3-capacity 32-gallon F. S. mixture.

(*h*) FRESH WATER: 200 gallons (approximate).

(*i*) FUEL: 3,000 gallons high octane gasoline.

(*j*) LUBRICATING OIL: 30 gallons.

(*k*) FRESH PROVISIONS: Four days rations for nine men and two officers.

(*l*) COMMUNICATIONS: Blinker tube semaphore, M. P. signal light, 8-inch searchlights, TCS voice radio set, range about 75 miles.

(*m*) RADIO DIRECTION FINDER: One R. D. F. set per boat.

(*n*) MACHINERY:

Main engines-three 1,200-hp. Packard 4-M2500.
Auxiliary generator-two 1/2-kw. water-cooled generator.
Power-four 6-volt storage batteries 24 volts.
Shafts-three shafts, three propellers (all right-hand).
Rudders-three rudders, mechanical steering.

(o) CRUISING RADIUS (see table in back of book):

Full load maximum speed _____ knots _____ miles;
Full load maximum sustained speed _____ knots _____ _____ miles;
Full load one engine _____ knots _____ miles.

(3) PT 95 type-PTs 95-102 (Huckins Yacht Corp.)[1] length 80 feet; beam ____ feet; maximum draft ____ feet; displacement ____ pounds.

(a) GUNS:

Four .50-caliber air-cooled B. A. machine guns in two twin, hand-operated scarf ring mounts.
One 20-mm. Oerliken mount.
One .45-caliber Thompson submachine gun.
Two .30-caliber Springfield rifles.
Thirteen .45-caliber Colt pistols.

(b) AMMUNITION-20-mm.:

Allowance-1,200 rounds.
Carried on board-480 rounds in eight 60-round magazines (ratio one Tr. to one H. E.).

50-caliber:

Allowance-10,000 rounds per gun.

--
[1] Complete information not available and blanks should be filled in when information is obtained.

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Carried on board-1,000 rounds per gun belted (ratio one Tr. to one A. P.) in four 250-round magazines per gun.

.45-caliber:

Allowance-4,000 rounds ball.
Carried on board-All.

.30-caliber:

Allowance-1,200 rounds.
Carried on board-All.

(c) TORPEDOES: four 21-inch Mark 8-3 C and D, speed 27 knots, range 13,500 yards. (If depth charges and 20-mm. gun are mounted, only two 21-inch torpedoes are carried, the others are held in reserve.)

(d) TORPEDO TUBES: Four 21-inch Mark 19 bow launching (only two tubes mounted if 20-mm. gun and depth charges are mounted).

(e) DEPTH CHARGES: Eight Mark 6 (300-pound charge).

(f) DEPTH CHARGE RACKS: Eight individual side launching type "C."

(g) SMOKE SCREEN GENERATOR: Mark 3; capacity 32-gallon F. S. mixture.

(h) FRESH WATER: 200 gallons (approximate).

(i) FUEL: 3,000 gallons high octane gasoline.

(j) LUBRICATING OIL: 30 gallons.

(k) FRESH PROVISIONS: Four days rations for nine men and two officers.

(l) COMMUNICATIONS: Blinker tube, semaphore, M. P. signal light, 8-inch searchlight, T. C. S. voice radio set, range about 75 miles.

(m) RADIO DIRECTION FINDER: One R. D. F. set per boat.

(n) MACHINERY:

Main engines-Three 1,200-hp. Packard 4-M2500.
Auxiliary generators-Two 1/2-kw. water-cooled generators.
Power-Four 6-volt storage batteries 24 volts.
Shafts-Three shafts, three propellers (all right hand).
Rudders-Three rudders, mechanical steering.

(o) CRUISING RADIUS (see table in back of book):

Full load maximum speed ____ knots ____ miles.
Full load maximum sustained speed ____ knots _____ miles.
Full load one engine ____ knots _____ miles.

(4) PT 103 type-PTs 103-196 (Elco Boat Works). Length 80 feet 3 inches; beam 20 feet 10 3/4 inches; max. draft 5 feet 3/4 inch; displacement 100,000 pounds.

(a) GUNS:

Four .50-caliber air-cooled B. A. machine guns, two twin, hand-operated scarf ring mounts.
One 20-mm. Oerlikon mount.
One .45-caliber Thompson submachine gun.
Two .30-caliber Springfield rifles.
Thirteen .45-caliber Colt pistols.

(b) AMMUNITION:
20-mm.:

Allowance-1,200 rounds.
Carried on board-480 rounds in eight 60-round magazines (ratio one Tr. to one H. E.).

.50-caliber:

Allowance-10,000 rounds per gun.
Carried on board-1,000 rounds per gun belted (ratio one Tr. to one A. P.) in four 250-round magazines per gun.

.45-caliber:

Allowance-4,000 rounds ball.
Carried on board-All.

.30-caliber:

Allowance-1,200 rounds. Carried on board-All.

(c) TORPEDOES: Four 21-inch Mark 8-3 C and D, speed 27 knots, range 13,500 yards. (If depth charges and 20-mm. gun are mounted, only two 21-inch torpedoes are carried, the others are held in reserve.)

(d) TORPEDO TUBES: Four 21-inch Mark 18-1 bow launching (only two tubes mounted if 20-mm. gun and depth charges are mounted).

(e) DEPTH CHARGES: Eight Mark 6 (300-pound charge).

(f) DEPTH CHARGE RACKS: Eight individual side launching type "C".

(g) SMOKE SCREEN GENERATOR: Mark 3, capacity 32-gallon F. S. mixture.

(h) FRESH WATER: 200 gallons (approximate).

(i) FUEL: 3,000 gallons high octane gasoline.

(j) LUBRICATING OIL: 30 gallons.

(k) FRESH PROVISIONS: Four days rations for nine men and two officers.

(l) COMMUNICATIONS: Blinker tube, semaphore, M. P. signal light, 8-inch searchlight, TCS voice radio set, range about 75 miles.

(m) RADIO DIRECTION FINDER: One R. D. F. set per boat.

(n) MACHINERY:

Maine engines-three 1,200-hp. Packard 4-M2500.
Auxiliary generator-two 1/2-kw. water-cooled generator.
Power-Four 6-volt storage batteries 24 volts.
Shafts-Three shafts, three propellers (all right hand).
Rudders-Three rudders, mechanical steering.

(o) CRUISING RADIUS (see table in back of book):

Full load maximum speed ____ knots, ____ miles.
Full load maximum sustained speed ____ knots, ____ miles.
Full load one engine ____ knots, ____ speed

CHAPTER 2. EMPLOYMENT

1201. Rough seas, especially from ahead, reduces the effectiveness of the boats and limits the endurance of the crews. However, in surprise attacks the enemy should, if practicable be approached from down wind unless engines are muffled.

1202. The wakes of motor torpedo boats at high speeds are visible considerable distances, both from the

air and surface. The wake of center engine is less visible than that of wing engines. These factors should always be considered when planning operations unless satisfactory wake camouflaging apparatus is installed.

1203. Comparative difficulty of detection, when properly camouflaged is characteristic favorable to the motor torpedo boat type. Surprise is one of its potential offensive weapons. This will lead to employment of these vessels in unsupported operations, mostly at night or in low visibility.

1204. Employed in tactical units of relatively large numerical strength, the motor torpedo boat squadron becomes a powerful offensive weapon. These squadrons may operate from a fleet base or from the motor torpedo boat carrier. It has been considered feasible to develop a carrier by which squadrons of MTB's could be carried, launched and recovered at sea.

1205. Motor torpedo boat squadrons based at strategic points for the defense of important passages, straits and restricted areas, will be effective as striking forces to deliver surprise attacks upon enemy surface units approaching or attempting to pass through areas within the radius of operations, and to deny such areas to the enemy.

1206. In cases of necessity, motor torpedo boats armed with depth charges, radar and portable listening gear might be employed effectively off shore combatting enemy submarine attacks against coastal shipping. During daylight operations of this kind, the motor torpedo boats should operate in coordination with aircraft or disguised as fishing vessels. During night or low visibility motor torpedo boats could operate with larger radar equipped vessels or separately, relying on their potential surprise features to encounter and attack with torpedoes, guns, and depth charges, submarines which were proceeding on the surface.

1207. In harbors and shallow water areas, where specially small type enemy submarines have operated, motor torpedo boats have proved effective in combatting them. In this connection, motor torpedo boats are at present the only vessels which can launch depth charges in shallow water and successfully escape damage from their explosions.

1208. Motor torpedo boats have been employed for coastal and harbor approach escort duties. However, their limited sea keeping qualities and short cruising radius restrict this employment to emergency conditions.

1209. When motor torpedo boats are based so that enemy waters are within their cruising radius they can be used to lay mines close inshore and in harbor entrances using depth charge racks to carry the mines.

1210. Every effort must be exerted by motor torpedo boat personnel to obtain the greatest results with actual and potential weapons, which is inflicting maximum damage on the enemy. In no case should a

vessel sink with torpedoes or ammunition on board if they can be fired at an enemy.

1211. Instructions governing the uses and procedures in handling actual weapons are contained in part 4 of this publication. The general doctrines to be observed follow in the next chapter.

CHAPTER 3. ATTACK DOCTRINE

Daylight Torpedo Attacks

1301. The considerations governing torpedo attacks differ widely depending:

(a) Whether attacks are to be made in daylight high visibility or at night and during low visibility.

(b) Whether massed attacks will be conducted by several squadrons or individual attacks by units of a squadron.

(c) On the type of enemy to be attacked and whether attack is to be supported or unsupported.

1302. Daylight attacks under good visibility conditions might be launched upon the following objectives:

(a) Attacks upon enemy merchantmen.

(b) Massed attacks upon enemy convoys.

(c) Attacks upon enemy raiders or convoys under cover of a smoke screen.

(d) Supported attacks in fleet actions if operating from a fleet base or carrier.

1303. The effectiveness of these types of attacks depends primarily upon the density of torpedoes which pass through the enemy formation.

1304. The majority of torpedo misses usually pass astern. Every effort should be made to plan the approach so the firing point is well on the enemy bow. Motor torpedo boats will be less visible on an approach from ahead; it is likely the enemy will have less fire power directly ahead; and if the enemy changes course in either direction there still remains a possibility of obtaining an attractive track angle.

1305. The effectiveness of a daylight attack may be augmented by the following factors:

(a) Simultaneous massed attacks pushed home to close ranges.

(b) Support of other craft in countering opposition.

(c) Approaching under cover of smoke.

(d) High-speed and zigzag approach.

(e) Avoiding enfilade.

1306. If circumstances do not favor or warrant an expectation of successful escape, motor torpedo boats will close to an absolute decisive torpedo firing range.

1307. The attack unit is usually the motor torpedo boat division (2, 3, or 4 boats) and although the approach may be made in suitable squadron formation, prior to reaching the firing point attack units will normally be released and dispersed to present a multiplicity of targets and divide the enemy's gun fire.

1308. The type of enemy being attacked and whether the attack will be supported or not, will usually determine the attack plan to be employed. Attack plans are covered in part 3 of this publication.

CHAPTER 4. ATTACK DOCTRINE

Night and Low Visibility Torpedo Attacks

1401. The effectiveness of an attack under these conditions depends primarily on approaching the enemy to close ranges undetected, where a reasonably accurate estimate may be made of his rate and direction of movement.

1402. In planning an attack at night or in low visibility, means of augmenting its effectiveness will usually be governed by:

(a) Accurate information of the enemy position, course and speed.

(b) Selection of favorable approach area based on enemy position, state of wind and sea.

(c) Full exploitation of surprise element.

(d) High speeds after decision is made to attack.

(e) Coordination of attack units and wave attacks.

(f) Firing torpedoes at close ranges.

(g) Coordination of attack with aircraft or other surface units.

1403. The possibility of reaching favorable positions at close range undetected are enhanced by the following factors:

(a) Silent approach, (engines muffled) with a favorable wind.

(b) Invisible wake. (Slow speed or a choppy sea or wake camouflaged.)

(c) Minimum silhouette presentment. (Bow pointed toward the enemy.)

(d) Proper camouflage. (Hull and superstructure completely nonspecular. No reflecting surfaces.)

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1404. In this type of attack, after being detected, machine gun fire against the enemy bridge, control stations and searchlights should be directed with maximum volume.

1405. Motor torpedo boat personnel must acquire a sense that will tell them whether at night they can be seen by the enemy or not. Generally speaking there is a tendency to underestimate distances at night.

1406. Similar to daylight attacks the most desirable approach is from ahead, and the firing point should always be well forward of the beam.

1407. When sea and weather conditions are unfavorable for close observation, it may be practicable at times to lie to, in areas where the enemy will have to pass through.

1408. When suddenly encountering an enemy at night undetected from an unfavorable attack position, and conditions warrant, engines should be reversed, backing away well clear, before increasing speed to gain a more favorable position. This will decrease chances of being detected by the wake.

1409. In planning an attack on an enemy force of heavy ships tightly screened by lighter forces, consideration should be given to the following:

(a) Sending in small units from various different points to cause the enemy to disclose his composition and disposition.

(b) First attack units to concentrate on screening vessels in order to permit later attack units to penetrate the screen unmolested.

1410. After contact with the enemy has been established at night, it is usually desirable to conduct attacks by individual boats considerably dispersed.

1411. When the objective enemy force is well screened it will sometimes be profitable under certain conditions, to trail the enemy from ahead and outside his range of motor torpedo boat detection, in order to fully develop the enemy formation, disposition and composition. This may increase the chances of filtering -through the screen later to reach the main objective.

1412. In firing torpedoes at very close ranges the distance required for the exploder to become fully armed, should always be considered.

1413. The fact that the enemy illuminates with a searchlight in the near vicinity of the motor torpedo boat does not always indicate that the boat has been discovered. Searchlight rays

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may sweep across the boat if motionless, without it being discerned. On the other hand if the boat is making considerable speed the searchlight may pick up the boat by sweeping along its wake. It is also possible that motor torpedo boats may be detected by radar. However, experiments conducted to date with our own surface vessels have indicated that this method has not proved very successful in detecting MTB's.

1414. When contact with the enemy has been made and a closer or better attack position is considered desirable, further maneuvers should be made in a manner that will permit discharge of appropriate weapons instantly. For example: all guns should be prepared and directed at the enemy, a lead angle maintained for discharging torpedoes, all unclutched engines ready for immediate engagement and the smoke screen generator ready for immediate operation.

CHAPTER 5. ATTACK DOCTRINE

Depth Charge Attacks-Anti-Submarine Operations

1501. After expenditure of torpedoes, the opportunity to depth charge surface vessels may arise, particularly at night, and should be seized whenever possible. By proceeding at high speed across the enemy's bow, and launching depth charges set at shallow depths, severe damage to an enemy surface

vessel may be inflicted. During the course of this operation a heavy volume of machine gun fire directed at bridge and control stations should be maintained.

1502. Depth charge attacks delivered in the daytime would normally consist of the following:

(a) Attacking a periscope which had been sighted.

(b) Depth charging in spots where other indications on the surface made it appear that a submarine was operating, submerged.

(c) Depth charging spots at the direction of aircraft, when working in conjunction with aircraft.

(d) Depth charging spots where listening or other form of sound apparatus indicated the presence of a submarine.

1503. When attacking a periscope which has been sighted, every effort should be made to determine as accurately as possible the rate and direction of its movement. An analysis of unsuccessful depth charge attacks made in the present war,

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indicates in nearly every case that insufficient allowance was made in leading the submarine, resulting in depth charges exploding astern. In this connection the following table lists the distances that the Mark 6 (300-pound charge), depth charge must explode, relative to hull of submarine, and the damage to be expected.

Distance from submarine hull	Damage to submarine
150-90 feet	Negligible.
90-50 feet	Perhaps some.
50-30 feet	Moderate.
30-10 feet	Probably fatal.

The British have analyzed the situation and have stated that the lethal distance of a depth charge explosion depends on the type of submarine attacked and position of damage on hull. Also that the distances given below are generally accepted as the maximum for a "kill," while explosions at double the distances may bring a submarine to the surface.

450-pound depth charge 21 feet.
250-pound depth charge 16 feet.

1504. A submarine, submerged at periscope depth, may be from 50-75 feet under the surface. Depth charges exploded under a submarine will probably do more damage than those exploding above. Therefore, if a periscope is sighted and the attack launched immediately thereafter, the first depth charges should be set at least 50-100 feet and later ones set at great depths.

1505. When a submarine is actually known to be operating in the vicinity it should be hunted relentlessly. If it is not possible to destroy the submarine it should be kept down and made to use up reserve battery energy. Running slow it is possible for a submarine to remain submerged no longer than about 48 hours.

1506. A submerged submarine may give off air bubbles or show traces of oil. Approximate speeds of ascent of oil and air may be accepted as:

Air 1.5 feet per second.
Oil 0.5 feet per second.

An oil streak from a submerged submarine would probably be V shaped and quite clearly defined. In any case the importance of "lead" should not be forgotten since the submarine will definitely have way on, and the one place he **will not** be is the exact spot where he was last seen.

1507. Motor torpedo boats, conducting antisubmarine operations during daylight, might work in conjunction with aircraft antisubmarine patrols. In such operations the motor torpedo boats would probably occupy assigned stations in certain areas and be in communication with the aircraft patrols. Any aircraft sighting a submarine would then immediately call the nearest boat or boats to the vicinity of the submarine contact, and direct the attack.

1508. If independent operations against enemy submarines or surface vessels are contemplated some distance off shore by motor torpedo boats, it probably would be feasible for the latter to be disguised as fishing vessels during daylight for the run out, and remove the disguise during hours of darkness.

1509. Successful antisubmarine operations by motor torpedo boats are most likely to be effected at night in off shore areas, where submarines may be attacking coastal shipping or convoys, or where submarines may attempt to shell strategic points. Nearly all successful enemy submarine attacks at night have been made from the surface.

1510. The possibility of a motor torpedo boat encountering, surprising, and torpedoing an enemy submarine on the surface at night is not too remote. However, such an encounter will require extreme vigilance, alertness and quick action on the part of motor torpedo boat personnel, since the submarine will probably also be maintaining a careful and vigilant lookout watch.

1511. An enemy submarine proceeding on the surface at night would probably elect, at the first sign of danger, to defend itself with gunfire or to crash dive. In case of the former, a heavy volume of machine gun fire directed at the conning tower and gun stations, followed by firing torpedoes would be most effective. In case of the latter, rapid discharge of torpedoes followed by a depth charge attack would be most effective. In any event during daylight or darkness, the entire motor torpedo boat armament must be manned and ready for instant use.

1512. Submarines use Diesel oil, which is a light oil having a distinctive and rather strong odor. If wind conditions are favorable, a submarine on the surface charging batteries at night might be detected by smell of the oil considerably farther away, than by sighting him.

1513. Motor torpedo boats equipped with radar, operating in conjunction and communication with a larger vessel such as tender equipped with radar, are further considerations for night antisubmarine warfare.

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PART 2. TACTICAL FORMATIONS AND ORDERS

CONTENTS

CHAPTER 1. GENERAL

2101. Formations.-It is essential that motor torpedo boat formations be small, wieldy, flexible, and as simple as possible. Difficulties in signaling and communications and the desirability of eliminating radio and signal communications, insofar as possible, make it mandatory that follow the leader tactics be used at all times whenever practicable.

2102. Personnel.-In order to operate effectively and efficiently in formation, it is necessary that motor torpedo beat personnel in boats following the leader, be indoctrinated in sensing or anticipating the desires or movements of the group leader and cooperate with their own actions and movements, to the fullest extent in attaining the objective. It will not always be possible, particularly at night, for the group leader to signal or make known his desires to the boats astern, before emergency action is required. For this reason, personnel in vessels astern must be strictly alert to all changes in conditions which may be encountered ahead and take appropriate action whenever the necessity therefor is indicated.

2103. Station keeping.-Every effort must be made to maintain the proper position in formation in order to facilitate visual signals and rapid maneuvering. When changes in formation are indicated, new positions should be attained, as expeditiously as possible. The success of many missions undertaken by motor torpedo boats will depend to a great degree on position. In order to gain favorable position and launch effective attacks,

ships' movements must conform to a definite plan. No plan can be effectively carried out without absolute coordination between the various units. It is therefore essential that units expeditiously attain and maintain their proper relative positions at all times.

2104. Division or group leader.-In maneuvering the unit or changing the formation, the group leader should at all times maneuver the leading boat to assist those astern in attaining and maintaining position. For example, decreasing speed or changing course of the leading boat will often permit an expeditious reforming of the disposition, whereas if the leader continued on a constant speed and course, boats astern might be long delayed in reaching their positions, although proceeding at maximum speed. In addition, the group leader must be fully aware of the capabilities of the boats astern and favor them accordingly. For example, some boats may be slower than others, due to condition of bottoms, machinery defects, etc.

2105. Standard distances, intervals and speeds.-No standard distances or intervals such as **close, standard** or **double** are prescribed in motor torpedo boats other than those indicated on the diagrams. The distances and intervals shown on the diagrams are within the limits of rapid signalling and deployment from cruising formations. Appropriate signals are provided for closing or opening these distances. No standard speeds are prescribed, as the necessity for constant changing of speeds due to character of the mission, state of sea, etc., and the ability of motor torpedo boats to readily conform to the speed changes of the group leader, make standard speed designations unnecessary.

2106. Order of ships-guide.-The initial order of ships in a division formation will normally be by hull numbers, although after execution of certain maneuvers in the manner prescribed, the order will not be maintained nor is it expected to maintain the initial order. Where reference is made to even numbered boats and odd numbered boats, position in division or squadron column counting the leading vessel in column as number 1, is referred to. In all formations the guide will always be the division, group or squadron leader. Initial order of divisions in a squadron formation, exclusive of the squadron commander's division, will normally be with the lower numbered division to

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the left or in the van. It is not expected that this order will be maintained after execution of certain maneuvers.

2107. Seniority.-In case the division leader leaves the formation, or is a casualty, the next senior boat in the division will automatically take charge of the formation and, if practicable, take the leading position regardless of previous position. If the squadron leader leaves the formation or is a casualty the senior division commander will take charge.

2108. Deployment.-Deployed formations are unwieldy and hence difficult to maneuver. Therefore, a flexible and wieldy formation should be maintained whenever practicable, until the approximate deployment course is reasonably certain. The formation should be led to this course by the division or group leader and then deployed ahead.

2109. Retirement.-Vessels of a single division, in retiring from an attack, will turn away from the center of the deployed formation unless otherwise directed. Whether to retire as a unit or to retire individually will usually depend on circumstances. If conditions warrant, boats should reform on the leader after retirement. Upon retirement all vessels should be extremely alert for signals from leader. In retiring from a simultaneous attack made by one or more squadrons, divisions will retire as a unit away from the center of the deployed formation, if practicable.

CHAPTER 2. THE DIVISION

2201. A division of motor torpedo boats is normally composed of **three boats**, but due to absent vessels, may be composed of only one or two boats. In temporary organizations it may sometimes consist of four boats. If more than that number are assigned to a mission, they should operate as separate two or three boat divisions.

2202. Division formation.-The basic formation for motor torpedo boats is the division formation. From this basis formation all maneuvers and evolutions follow. There are three division formations:

(1) Division column.
(2) Division V.
(3) Division echelon.

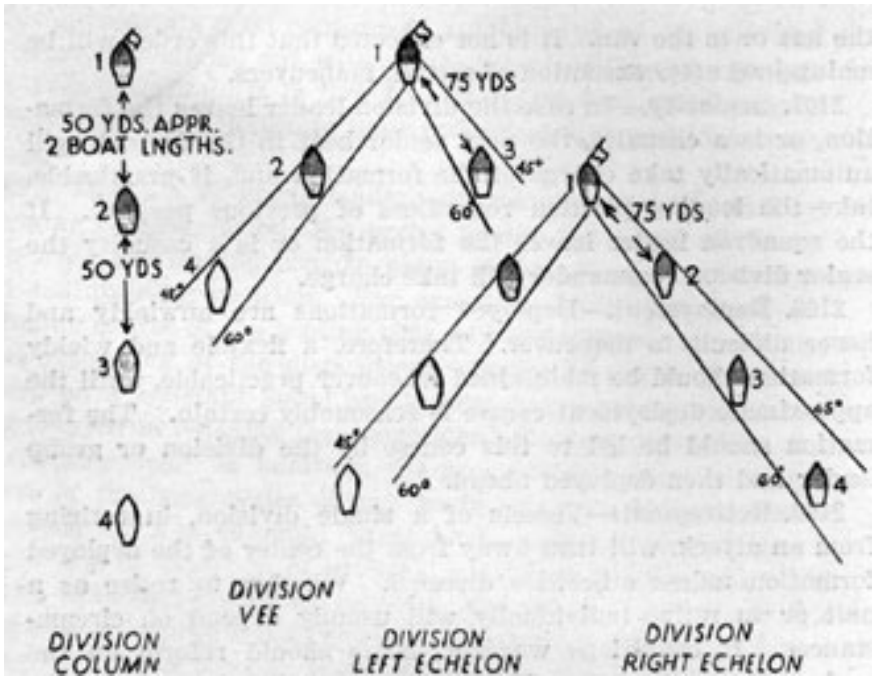

FIGURE 1.

CHAPTER 3. DIVISION FORMATIONS

2301. Uses of division column.-This formation is normally only used when entering or leaving harbor or passing through restricted waters, especially when there is no danger of attack by the enemy. Division Column should not be used when armament is in the ready condition. The disadvantages of this formation are:

(1) Division is vulnerable to enfilade fire by straffing aircraft or shore batteries.
(2) Rapid deployment ahead is difficult.
(3) Vessels astern are endangered by accidental discharge of ready guns and depth charges on vessels ahead.

Unless otherwise directed it will be standard practice to form division column without signal upon getting underway.

2302. How formed.-All vessels form in designated order astern of leader on a relative bearing of 180° (see Art. 2202),- with approximately 50 yards (two boat lengths) between boats.

2303. Maneuvering the division column.-The division column may be maneuvered by a simple change of the course by column movement following the leader or by simultaneous ships turns on turn or deployment signals.

2304. Deploying from division column.-Normally the division will not be in a column formation when required to deploy. In cases of emergency, however, it may become necessary. In deploying ahead the division leader maintains course and slows down as necessary to expedite forming the line. Odd numbered boats in column, should sheer out to starboard and even numbered boats to port, increasing speed as necessary to come into line abreast of division leader with about 100 yards four boat lengths) of open water between adjacent boats. In deployment to right or left, the division leader swings to deployment course immediately and all vessels change course simultaneously in the direction of deployment, increasing speed and opening up as necessary to form on line with division leader.

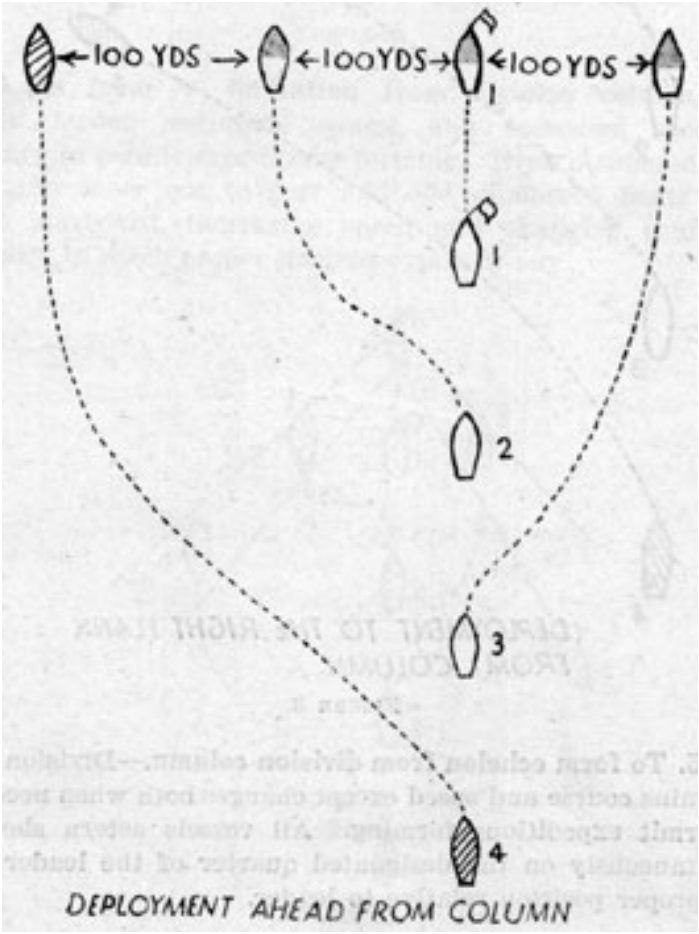

FIGURE 2.

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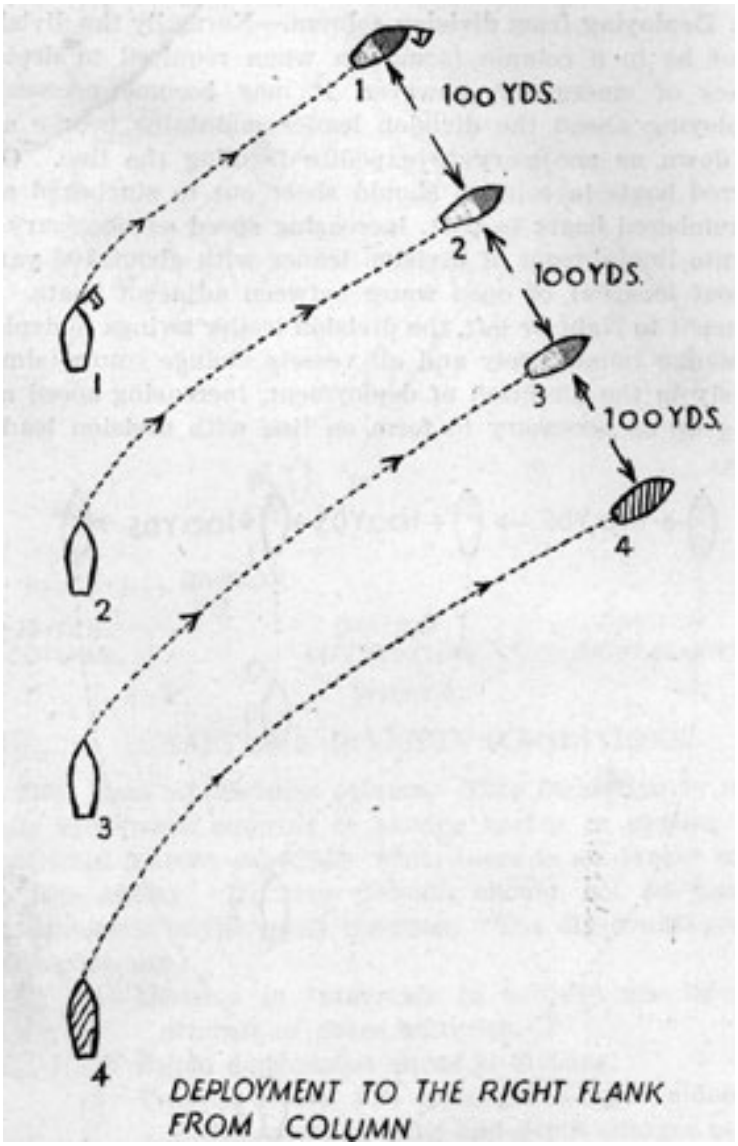

FIGURE 3.

2305. To form echelon from division column.-Division leader maintains course and speed except changes both when necessary, to permit expeditious forming. All vessels astern sheer out simultaneously on the designated quarter of the leader to attain proper position relative to leader.

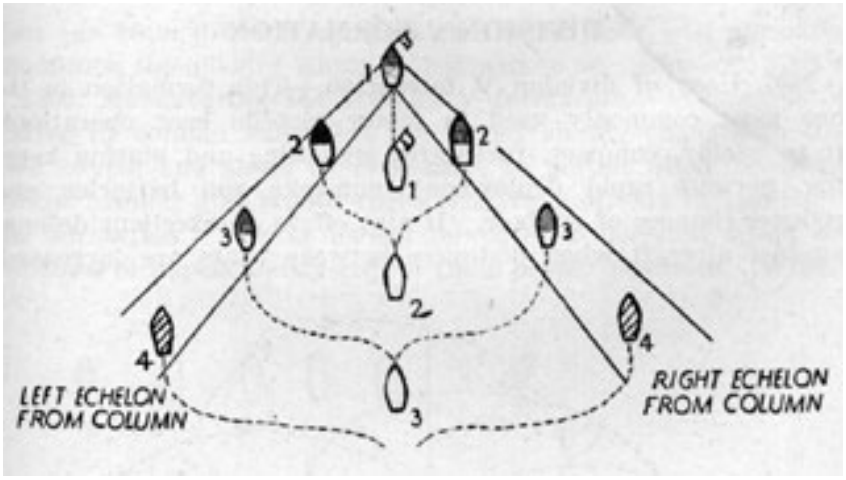

FIGURE 4.

2306. To form V formation from division column.-The division leader maintains course and decreases speed as necessary to permit expeditious forming. Even numbered boats in column sheer out to port and odd numbered boats sheer out to starboard, increasing speed and changing course as necessary, to reach proper stations expeditiously.

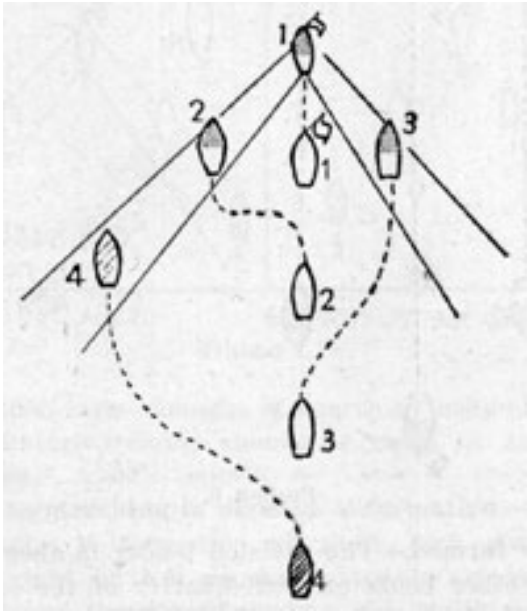

FIGURE 5.

DIVISION V FORMATION

2307. Uses of division V formation.-This formation is the one most commonly used in motor torpedo boat operations. It is wieldy, compact, facilitates signalling and station keeping, permits rapid deployment, unmasks gun batteries and reduces chances of enfilade. It also offers an excellent defense against aircraft when distances between boats are increased.

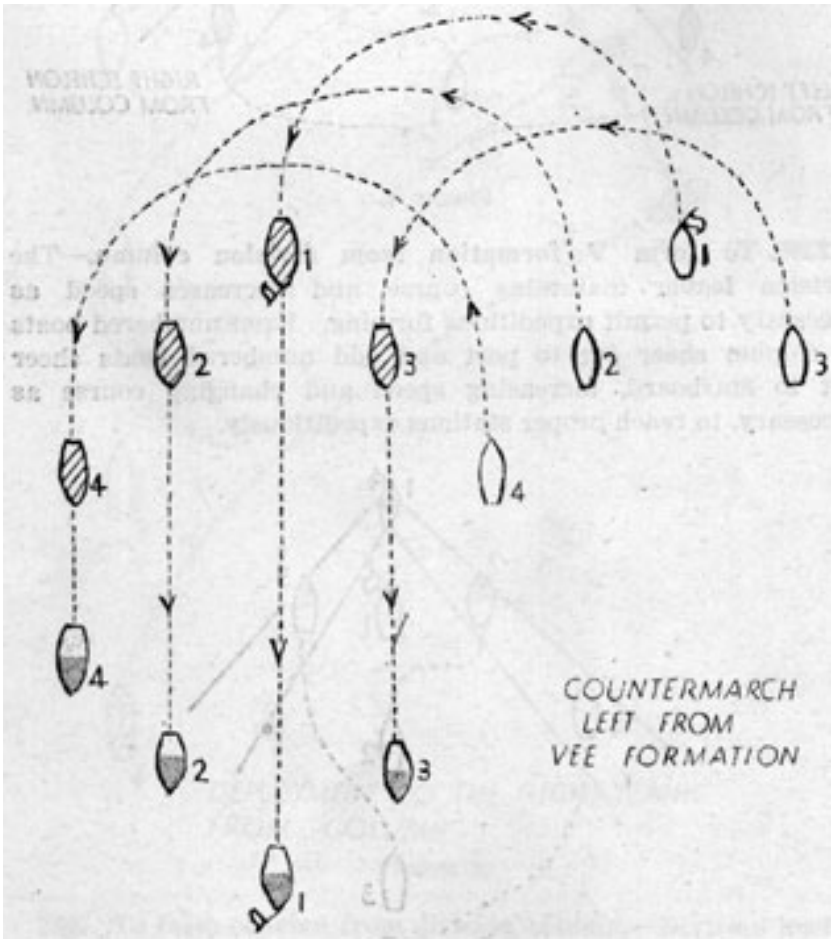

FIGURE 6.

2308. How formed.-The division leader is ahead and in the center; the other boats on each quarter of the leader, 45° to 60° abaft the beam, distance 75 yards. If four boats are present the fourth boat normally takes appropriate station on the port quarter of the division leader but he may be stationed on either quarter. When reforming the V from another formation

(as from division echelon) the fourth boat will normally remain on the quarter where he happens to be. (See art. 2202.)

2309. Maneuvering the division V formation.-In changes of course by column movement the leader simply changes to the new course and slows as necessary, to permit other boats to follow around and regain their relative positions to maintain the formation. Vessels astern increase or decrease speed as required to expeditiously regain their proper positions. Whenever,

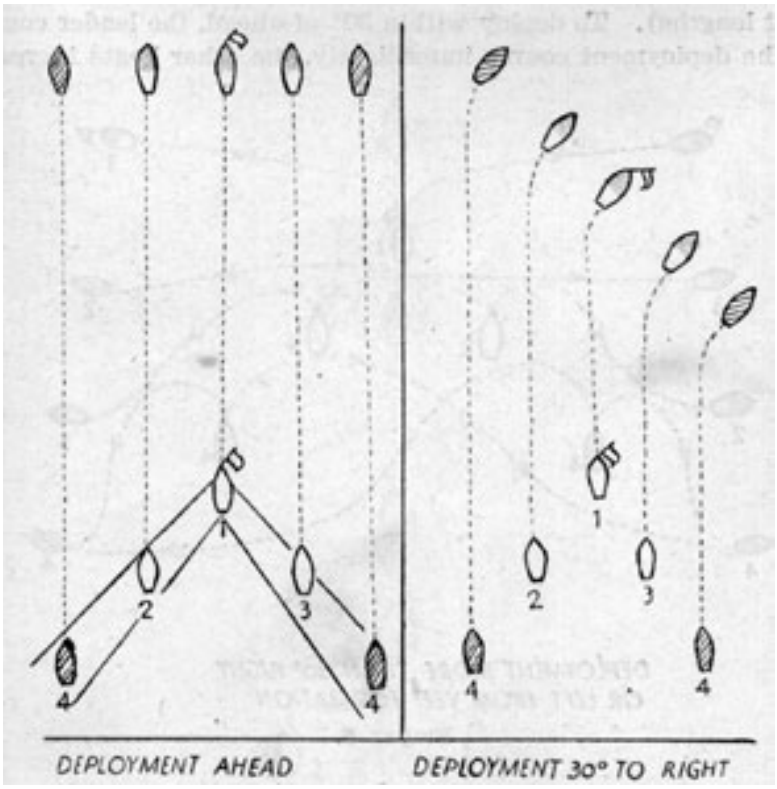

FIGURE 7.

practicable, large changes of course by column movement, except in countermarching, should be made by two or more course changes.

2310. Countermarching in division V formation.-To countermarch from the V formation all units turn simultaneously 180° to the right or left as designated by signal from the leader. When on the reverse course, the division leader cuts between the other two boats to retake proper position in the V formation. If four boats are present, the fourth boat, after completion of the 180° turn and when on the reverse course;

drops back to resume normal station, as the division leader cuts through.

2311 (a). Deployment ahead from division V formation.-Deployments from this formation will normally be ahead. The leader will usually, on the approach, maneuver the formation by follow the leader tactics to the deployment course. Upon signal to deploy, the boats astern increase speed, open up slightly and come into line abreast of the leader. Distance between adjacent boats is about 100 yards (approximately four boat lengths). To deploy within 30° of ahead, the leader comes to the deployment course immediately, the other boats increase

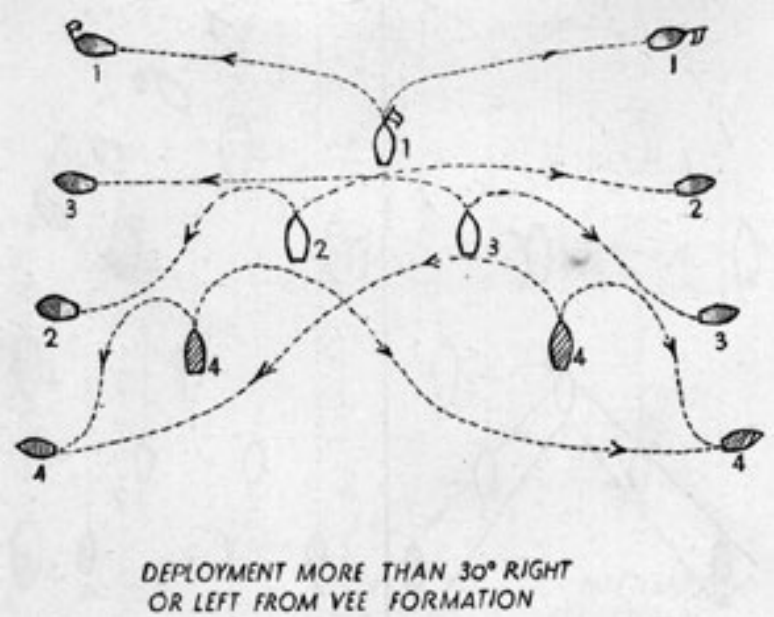

FIGURE 8.

speed, open up as necessary and come into line on either side of the leader.

2312 (b). Deployments right or left from division V formation.-Deployments greater than 30° from ahead should normally not be necessary except for emergencies or surprise encounters, where the enemy suddenly is sighted on or abaft the beam. These deployments are accomplished as follows: Leader holds course until other boats start to turn, then swings immediately to deployment course, maintaining maximum speed. The boat on the flank in direction of deployment turns sharply swinging past the deployment course then back to parallel the leader, in order to open out and make sea room for center

boat. The boat on the flank away from direction of deployment turns immediately to the deployment course, increases speed and cuts under stern of the leader to come into line.

2313. To form column formation from division V formation.-The division leader maintains course and speed except to change

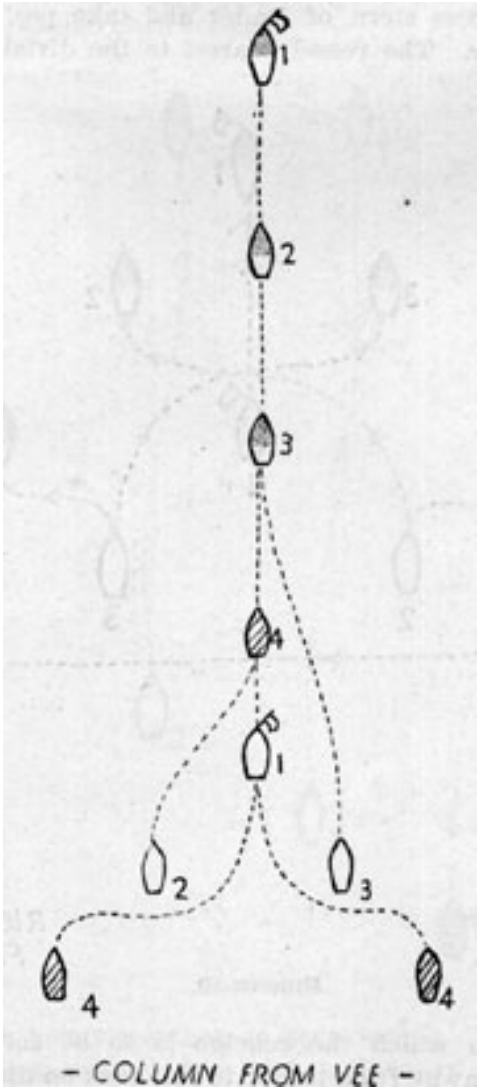

FIGURE 9.

either as necessary, to facilitate expeditious forming. The nearest boat on port quarter falls in next, astern of leader, and the nearest boat on starboard quarter falls in as third vessel in column. If four boats are present the fourth boat takes station as last in column.

2314. To form echelon from division V formation.-The division leader maintains course and speed, except changes either as necessary to facilitate rapid forming. The vessel nearest the division leader on that flank opposite to which the echelon is to be formed changes course and speed as necessary to cut across stern of leader and take position as next astern of leader. The vessel nearest to the division leader on

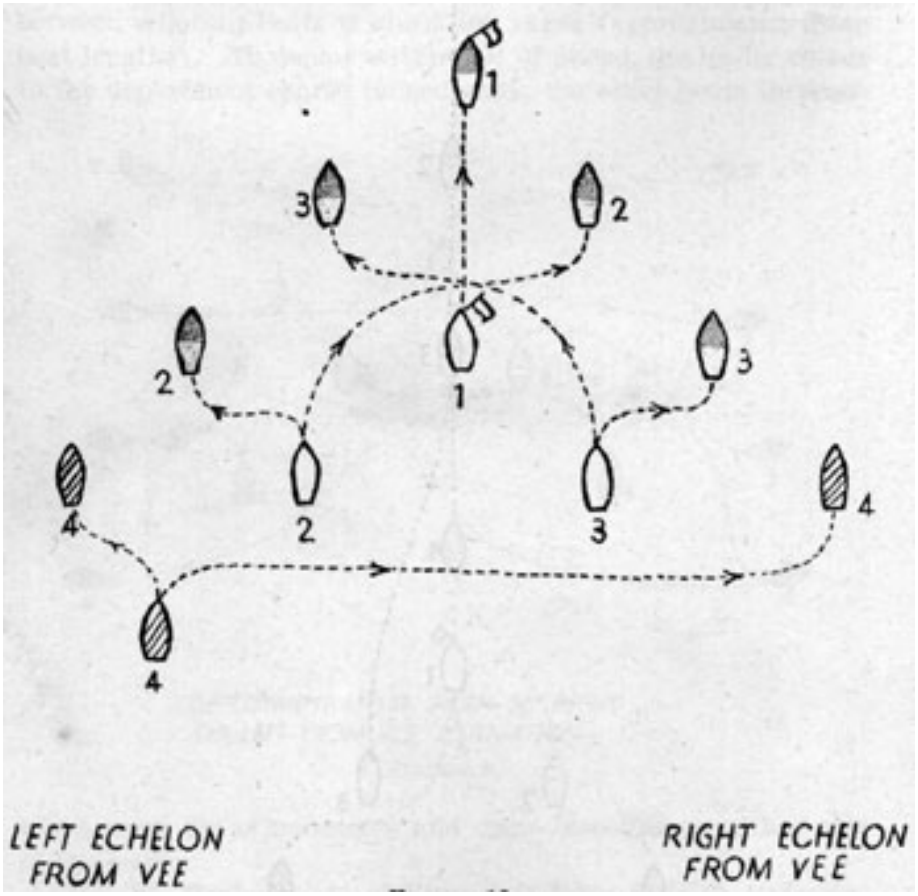

FIGURE 10

the quarter on which the echelon is to be formed changes course slightly away from leader to fall back on distance to take position as number three in the echelon formation. The fourth boat in the division falls back in proper position if already on the proper quarter of the division leader. If on the opposite quarter, he changes course and speed as necessary to take position as last boat in the echelon.

DIVISION ECHELON FORMATION

2315. Uses.-The division echelon formation may be employed under the following circumstances:

(1) When cruising off shore and position is doubtful, to keep vessels astern disposed to seaward of leader and more free of probable obstructions.

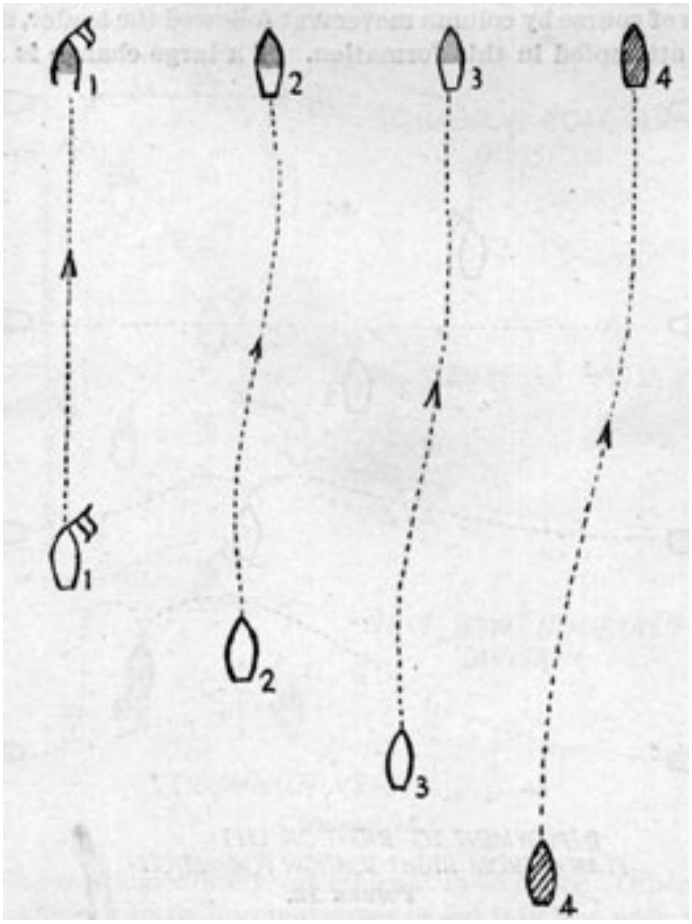

FIGURE 11

(2) In heavy weather, to keep vessels disposed to windward, so personnel may look to leeward for signals and facilitate station keeping.

(3) At night, prior to making contact with the enemy in order that leader may keep the majority of vessels disposed on his probably disengaged side.

(4) When conducting an attack under cover of a smoke screen.

It has the disadvantages of being more unyieldy, subject to enfilade, and does not facilitate rapid signalling in good weather.

2316. How formed.-Vessels form on the designated quarter of the leader from between 45° to 60° abaft the beam, distance 75 yards (three boat lengths) between adjacent vessels. (See art. 2202.)

2317. Maneuvering the division echelon.-Normally large changes of course by column movement followed the leader, should not be attempted in this formation. If a large change is necessary

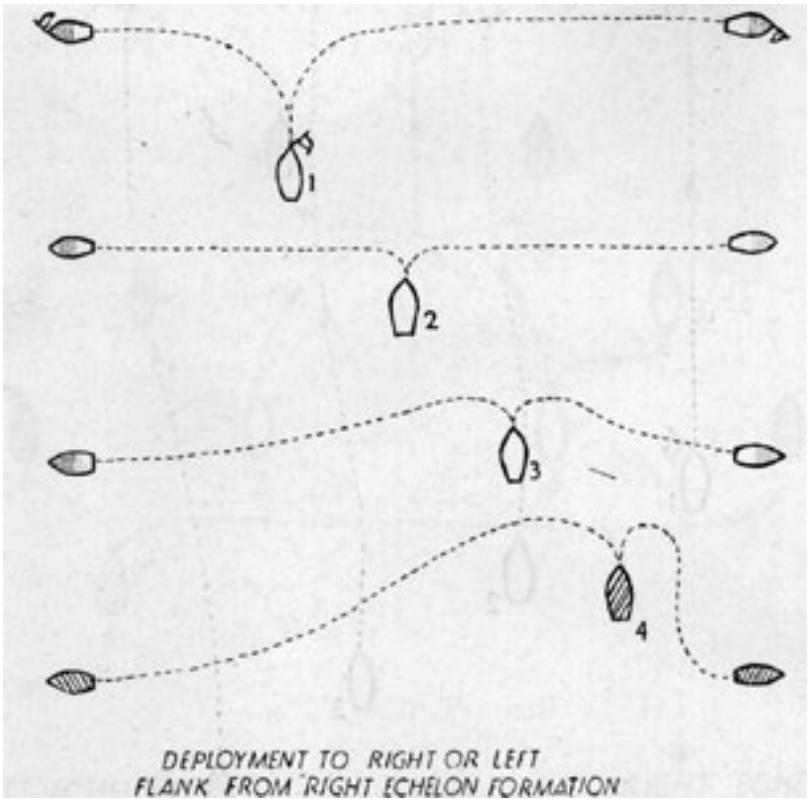

FIGURE 12.

it should be made by appropriate turn or deployment signals. However, if a large change is made by the leader without such signal, vessels should change course and speed as necessary to regain proper positions in the echelon.

2318 (a). Deploying ahead from division echelon.-Before deploying from echelon, the division leader will normally maneuver the formation to the deployment course so deployment may be made ahead. In deploying ahead from division echelon, the division leader maintains course and slows down as necessary to expedite forming of the line. Vessels astern, increase speed

and sheer out as necessary to come up in line abreast of division leader, with approximately 100 yards (four boat lengths) between adjacent boats when in line.

2319 (b). Deploying to the flank from echelon formation.-In case of emergency it may be necessary to deploy toward the flank, in which case upon appropriate deploy signal the division leader increases or decreases speed and changes to the deployment

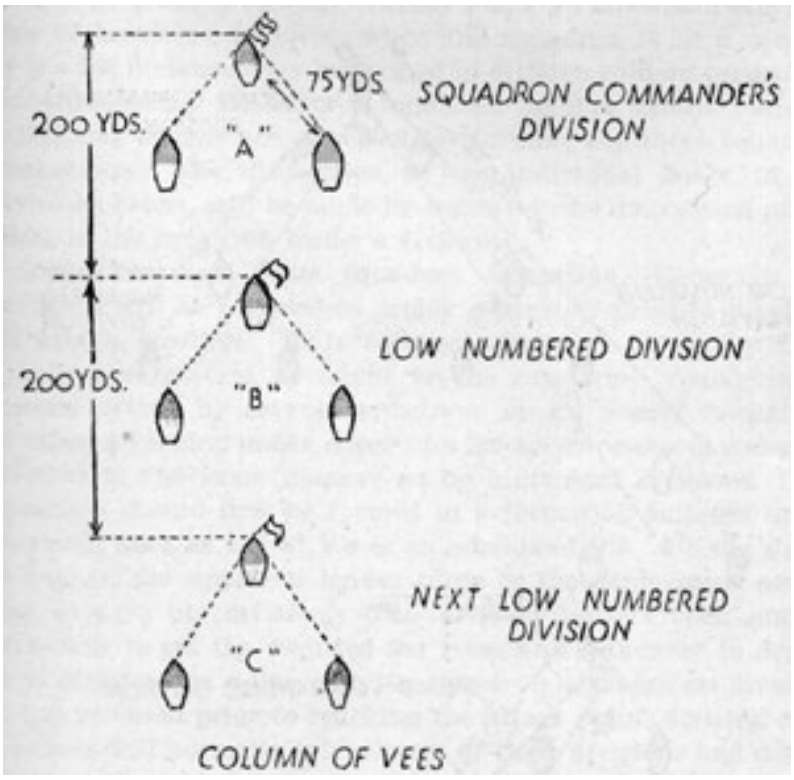

FIGURE 13.

course immediately, opening out in so doing. Other vessels turn simultaneously and maneuver to get into line with approximately 100 yards (four boat lengths) between adjacent boats.

CHAPTER 4. THE SQUADRON

2401. A squadron of motor torpedo boats is normally composed of two or more divisions. The squadron leader is also one of the division leaders.

2402. Squadron formations.-Squadron formations are necessary for the following purposes:

(1) Cruising.

(2) Operating with other units of the fleet.

(3) Leading the squadron to an attack position. They are normally only used in daylight operations.

2403. Types of squadron formations.-There are three basic squadron formations:

(1) Column of, V's.

(2) Vee of V's.

(3) Echelon of V's.

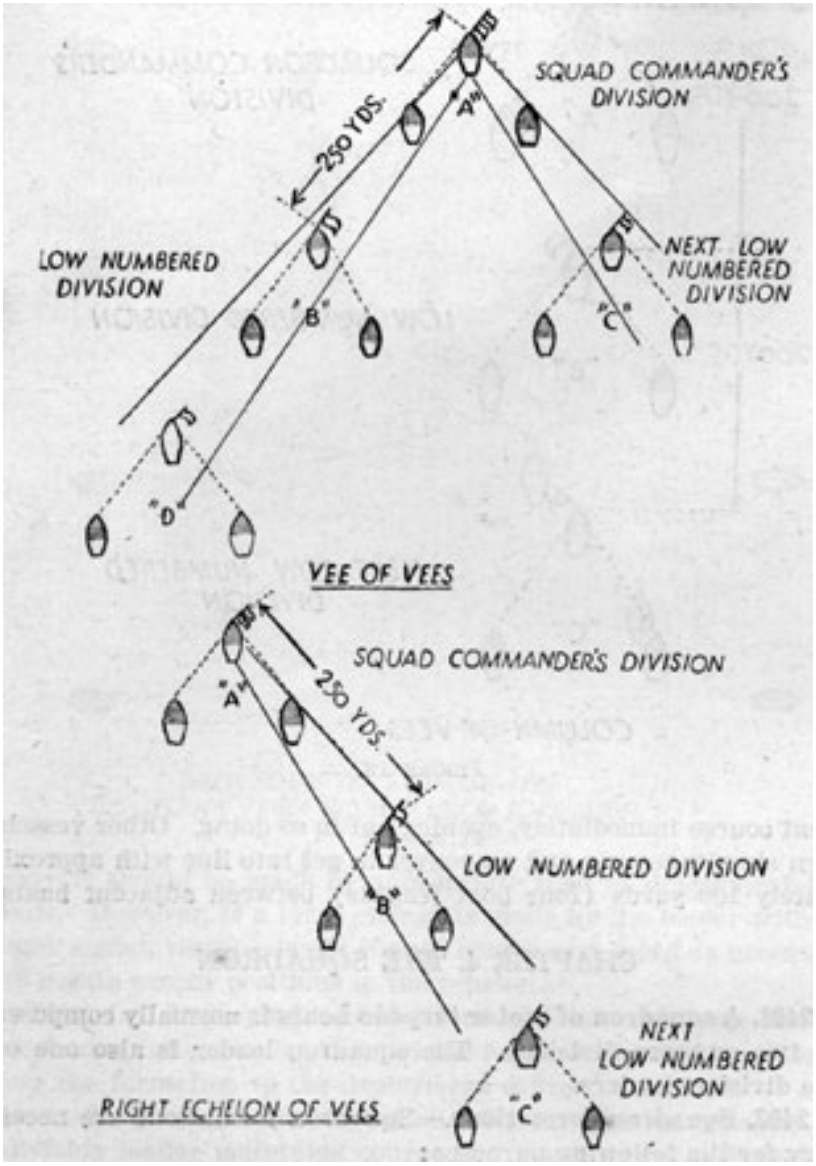

FIGURE 14.

2404. Maneuvering the squadron.-All maneuvers and evolutions prescribed for the division formation are applicable to the squadron formation and are accomplished in the same manner, using as units the divisions, instead of individual boats. While in any of the basic squadron formations, the divisions may be formed into any of the division formations. For example, while the squadron is in an echelon of vees, the divisions may be formed in division echelon, thereby placing all boats in one long line of bearing. Likewise when the squadron is in a column of V's the divisions may be formed in division column formation, thereby placing all boats in one long column astern. Appropriate flag signals are provided for forming the three squadron formations. The disposition of the individual boats in the divisions astern will be made by following the disposition of the boats in the squadron leader's division.

2405. Deployment from squadron formation.-Generally the divisions will be released to deploy separately prior to reaching an attack position. If it becomes necessary to deploy from squadron formation, as might be the case when conducting a massed attack by several squadrons on an enemy formation, or when attacking under cover of a smoke screen, deployment is effected in the same manner as by individual divisions. The squadron should first be formed in a formation suitable to deployment such as a V of V's or an echelon of V's. On the signal to deploy, the squadron leader turns to the deployment course and deploys his division. The division leaders open out as necessary to get the required sea room and maneuver to deploy their divisions on a line with the squadron commanders division. If not released prior to reaching the attack point, division commanders will normally take charge of their divisions and deploy without further signal when the squadron commander is observed to deploy his division. In retiring the retirement will usually be by divisions away from the center.

CHAPTER 5. TACTICAL SIGNALS

2501 (a). Hand and arm signals.-Hand and arm signals are provided for the more important maneuvers in case of emergency, when flags are not readily available or are lost overboard. They serve as a rapid means of signalling when entering or leaving harbors or for rapid dispersion of boats from a small compact formation. The arm signal is executed as soon as it is observed and is passed on by vessels nearest or adjacent to the

Arm signal	Meaning	Remarks
Arm held vertically upward, palm aft.	Slow and open up or I am decreasing speed.	Hold arm in position until formation is opened up as desired. Hold arm in position until repeated by next astern.
Arm extended vertically upward, fist clenched and brought rapidly downward several times as though tooting a whistle.	I am increasing speed or close up on me.	Make signal until repeated by next astern. Repeat signal until vessels are closed in as desired.
Both arms extended upward and hands clasped together as though shaking hands.	Division commanders or commanding officers take charge.	
Arm extended upward, rotated in circles several times and then brought down pointing astern.	Form division column	Repeat several times.
One arm vertical. Other arm extended and brought down several times pointing to quarter on which it is desired echelon be formed.	Form division echelon	Repeat several times.
Both arms extended upward and palms of hands clapped together several times after which one arm is brought down in direction of deployment.	Deploy in direction indicated.	Repeat several times.
Both arms extended upward at an angle of 45° with body and then brought down in the direction of the stern.	Form division V formation.	Repeat several times.
Both arms held vertically upward fists clenched and arms worked downward and upward several times in a rapid manner.	Attack with torpedos, depth charges or commence firing guns as appropriate, depending on target.	
Run index finger of hand around throat several times.	Shut off engines.	
Both arms held vertically upward and brought down extended horizontally in opposite directions.	Spread from 300-500 yards distance or interval on present bearing from leader and zigzag if necessary.	Repeat several times.

Arm held vertically upward and rotated in sweeping circles.	Scatter and maneuver to avoid gunfire or aircraft attacks in accordance with scatter plan.	
Both arms held vertically upward and waved across each other to form an X	Disregard movements of leader.	Repeat several times.

division leader, to those further away. Personnel should be familiar with hand and arm signals as well as flag signals.

2501 (b). Flag signals.-Flag signals in addition to arm signals are provided for maneuvering the division or squadron. Flags used have been selected for their distinctive colors and patterns. They are not direct reading and therefore the meanings must be memorized. The flag signals are repeated as soon as observed by vessels astern of leader. Vessels nearest the leader are responsible for relaying the signal to those further away. The signal of execution will be a separate, sharp and distinct movement of cutting the flag down out of sight. The signal of execution should be repeated by vessels nearest the leader for the benefit of those further away.

Flag	Signal	Meaning	Remarks
Division	Held vertically	Form division V formation.	Hold stationary.
Do	Waved and pointed toward the stern.	Form division column formation.	Wave in a fore and aft plane.
Do	Waved and pointed toward the starboard side.	Form division echelon to starboard.	Wave in an athwartships plane.
Do	Waved and pointed toward the port side.	Form division echelon to port.	Do.
Turn	Held at an angle of 45° toward the direction of the turn.	Boats turn simultaneously in direction flag is held following movements of leader.	Hold flag stationary.
Do	Waved and pointed toward the starboard side.	Countermarch to right.	Wave in an athwartships plane.
Do	Waved and pointed toward the port side.	Countermarch to left.	Do.
Victor	Held vertically	Deploy ahead	Hold stationary.
Do	Waved and pointed toward the starboard side.	Deploy to the right flank.	Wave flag in an athwartships plane.

Do	Waved and pointed toward the port side.	Deploy to the left flank.	Do.
Baker	Held vertically	Fire torpedoes	Hold stationary.
Do	Waved and pointed in direction of contact.	Attack with depth charges.	
Option	Held vertically	Lay smoke	Do.
Do	Waved in a fore and aft plane.	Scatter in accordance with plan.	To be executed on sight.
Do	Waved in an athwartships plane.	Spread accordance with plan on present bearing from leader.	Do.

Flag	Signal	Meaning	Remarks
Negative	Held vertically	Disregard my movements	Execute on sight.
Do	Waved from side to side.	Disregard last signal or cease firing.	Do.
		SQUADRON FLAG SIGNALS	
Zero	Held vertically	Form V of V's	Div. leaders repeat.
One	do	Form column of V's	Do.
Five	do	Form echelon of V's to right.	Do.
Nine	do	Form echelon of V's to left.	Do.

2501 (c). Light signals.

(1) Daytime uses.-Light signals are normally not used in the daytime for maneuvering purposes, due to the lack of adequate signalling apparatus, difficulties of reading light signals, and the unstability of the boat. However, when the division or squadron is dispersed as in a spread or scatter formation, the following light signal will be used to reform the division or squadron. This signal will be passed on by boats nearest leader to those further away.

Signal	Meaning	Remarks
Several long flashes	Close in on me to within flag signalling distance.	To be made on searchlight. If directed at division leaders reform on squadron leader.

(2) Night uses.-The following night signals may be used. They will be made by the leader only and will not be passed on or answered. They will be repeated twice by the leader and sent only when absolutely necessary and when their use will not disclose the position of the unit. They will be sent by blinker gun or small screened flashlight.

Signal	*Meaning*
B	Attack.
C	Close me for verbal instructions.
I	Increase speed.
D	Decrease speed.
R	Column right.
L	Column left.

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PART 3. ATTACK PLANS

CONTENTS

CHAPTER 1. GENERAL

3101. It must be thoroughly understood that the attack plans outlined herein are primarily type plans which are intended to serve only as a guide. No multitude of written plans can replace initiative, resourcefulness, and good judgment which every motor torpedo boat officer must exercise in planning and launching an attack.

3102. In planning and developing an attack it is imperative that the attack commander have a thorough knowledge of the boats which he commands, their strong points and weaknesses, their possibilities and limitations. He must understand his officers and men and they in turn must understand him, in order that his plans will be carried out even when things go wrong and communications are disrupted. Team work and indoctrination are the keynotes to a successful attack.

3103. The attack commander should make use of all the inherent advantages which the PT boat possesses and avoid as far as possible their weaknesses. He should use stealth in closing the range before being detected. He should seek a favorable attack course where the speed of his boats can best be used, taking into account the desirability of reducing spray. He should consider the direction of the wind for carrying sound and laying smoke. He should make use of sun glare to blind the enemy and moonlight to silhouette him, at the same time avoiding being blinded and silhouetted himself. He should take advantage of the enemy being otherwise engaged and coordinate his attack with other units whenever possible. In short, he must make use of everything favorable to press home the attack to decisive range.

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CHAPTER 2. ATTACKS ON ENEMY MERCHANTMEN OR AUXILIARIES

3201. In attacking a single unprotected enemy merchantman, transport or cargo vessel, the direction of attack is immaterial as the enemy is free to maneuver. In general, the boats engaged in the attack should press into decisive torpedo range, and the boat in the most favorable position should fire one or more torpedoes depending on the size of the vessel. Other boats should follow up the attack and fire torpedoes if necessary. Depth charges may be used to finish off a crippled vessel if torpedoes are not available.

3202. In attacking two or more unprotected enemy merchantmen, the same procedure should be followed as in attacking a single vessel except that boats of the attack force will pick "targets of opportunity", (targets which present themselves favorable for attacking) and will pursue enemy vessels should they scatter.

CHAPTER 3. ATTACKS ON ENEMY CONVOYS

3301. Daylight attack on enemy convoy or task force.-(a) Motor torpedo boats should be led in squadron formation(s) to favorable attack position (s) sharp on the bow of the convoy. At this point, the divisions should be released to press home simultaneously attacks, deploying as necessary to present a maximum multiplicity of targets. Divisions and individual boats will take advantage of opportunities as they arise and will pick their targets using normal distribution from van to rear. Here as never before, real teamwork comes into play in picking appropriate targets without encroaching on a flanking boat's territory.

(b) If it is possible, one or more divisions may be detached to attack the convoy from astern. This attack has a great advantage if it is timed a few minutes after the attack from ahead, to take advantage of any confusion and target maneuvers.

(c) If the wind is favorable (from ahead of convoy, or from attacking side), smoke should be used to screen the attack.

3302. Night attack on enemy convoy.-At night or in low visibility after reaching a favorable attack position, the individual boats should be released to press home their attack. There are two general plans for a night attack, the first, a mass attack which is similar to the daylight attack except that boats proceed independently; and the second, a wave attack where the

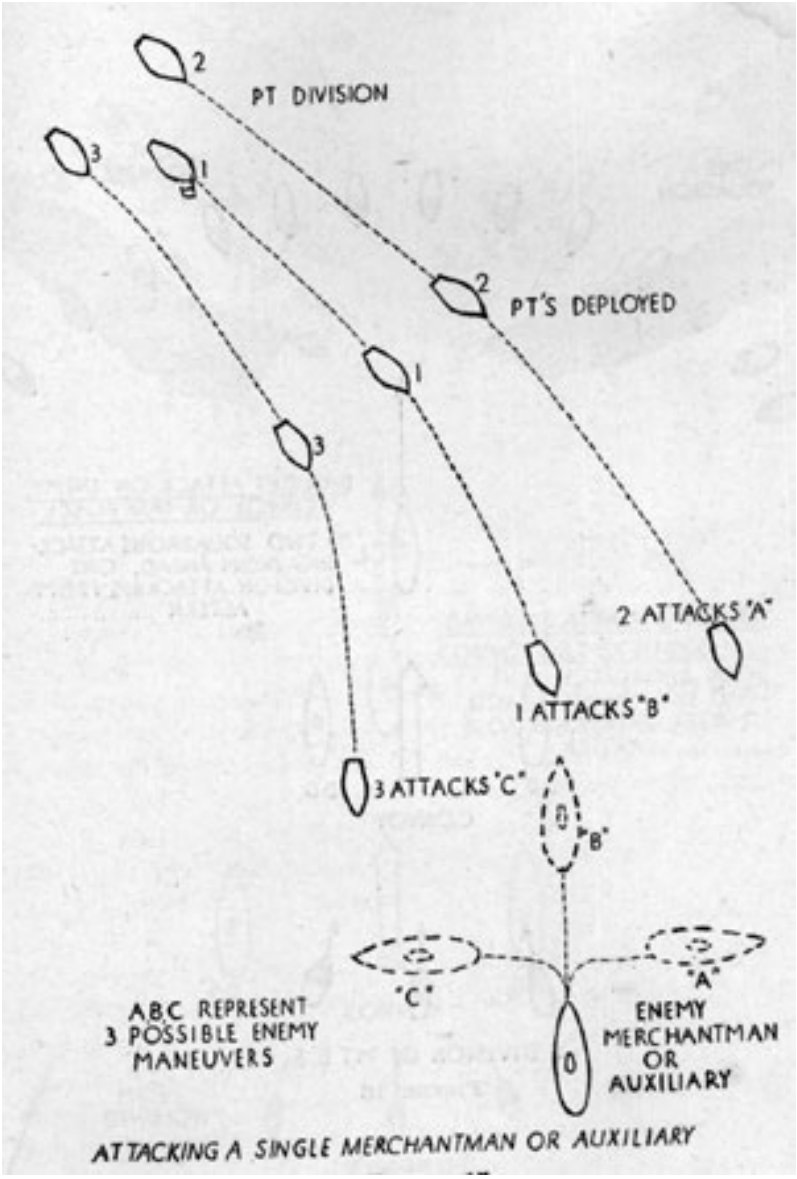
PT DIVISION
PT'S DEPLOYED
2 ATTACKS "A"
1 ATTACKS "B"
3 ATTACKS "C"
"B"
"C"
"A"
A,B,C REPRESENT 3 POSSIBLE ENEMY MANEUVERS
ENEMY MERCHANTMAN OR AUXILIARY
ATTACKING A SINGLE MERCHANTMAN OR AUXILIARY

FIGURE 15

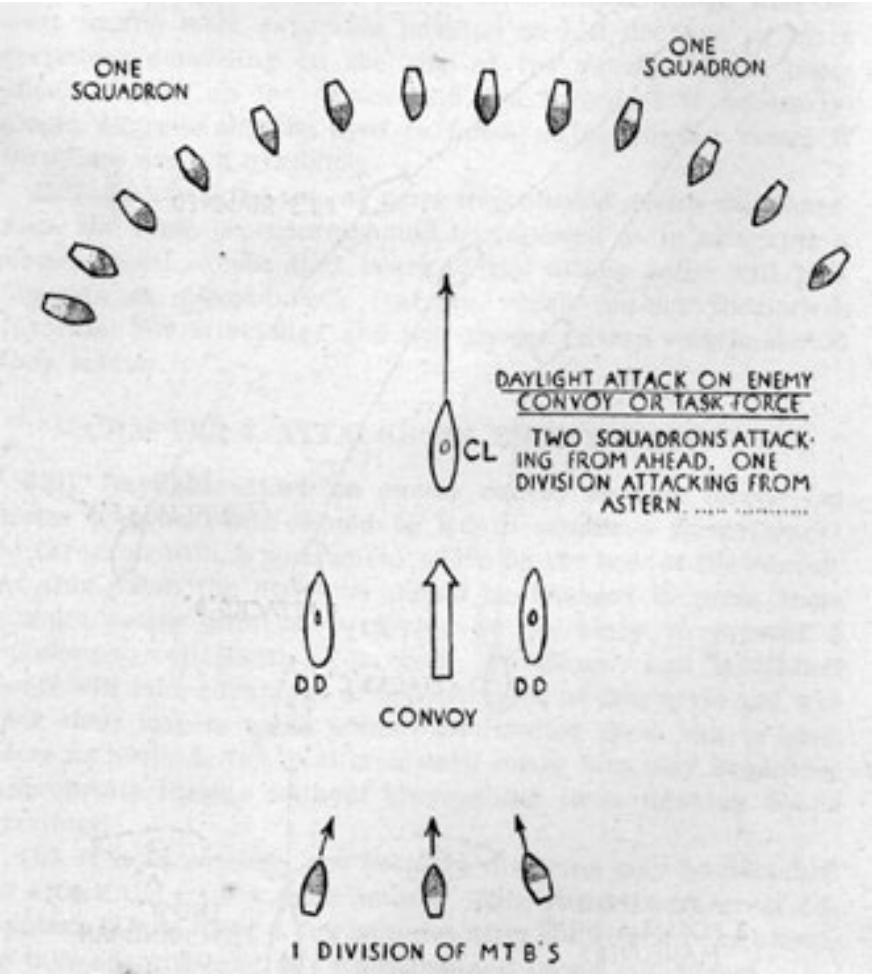
ONE SQUADRON
ONE SQUADRON
DAYLIGHT ATTACK ON ENEMY CONVOY OR TASK FORCE
CL
TWO SQUADRONS ATTACKING FROM AHEAD, ONE DIVISION ATTACKING FROM ASTERN.
DD
DD
CONVOY
1 DIVISION OF MTB'S

FIGURE 16

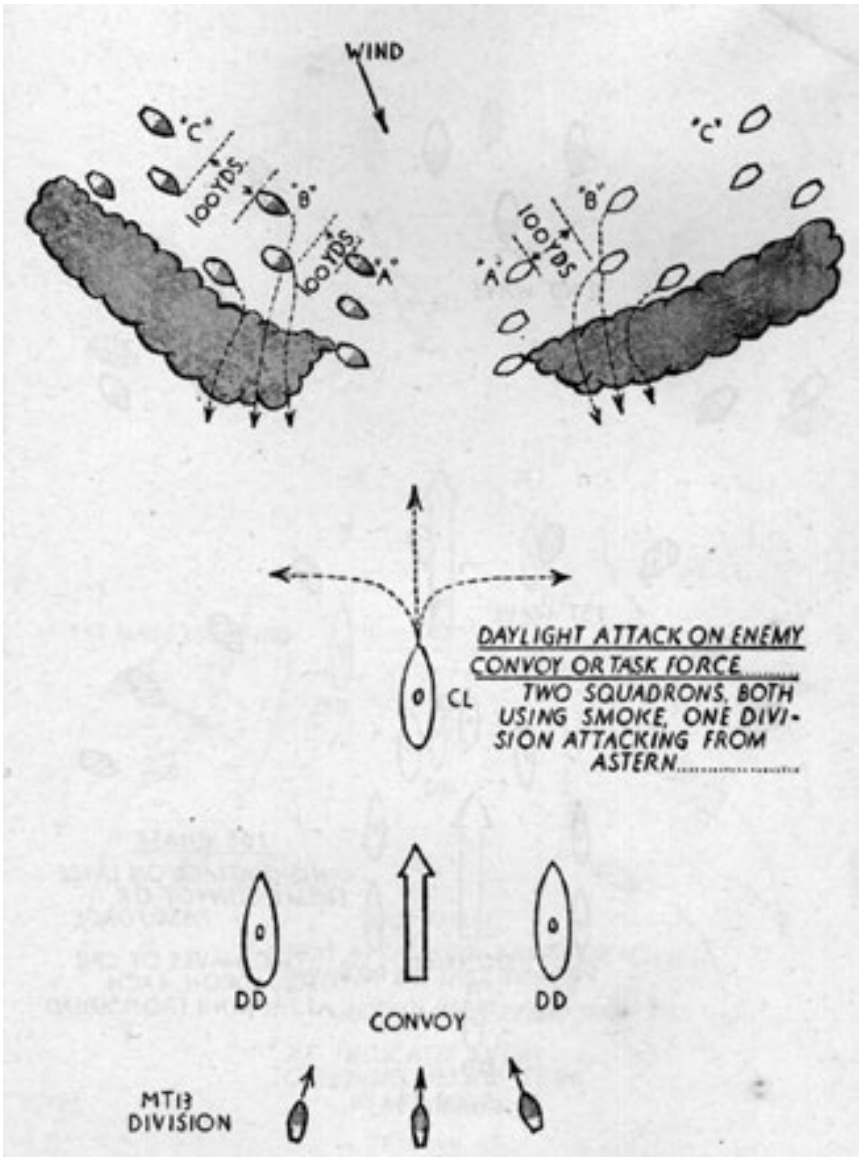
WIND
"C"
100YDS
"B"
100YDS
"A"
"C"
"B"
100YDS
"A"
DAYLIGHT ATTACK ON ENEMY CONVOY OR TASK FORCE.....
TWO SQUADRONS, BOTH USING SMOKE, ONE DIVISION ATTACKING FROM ASTERN.....
CL
DD
CONVOY
DD
MTB DIVISION

FIGURE 17.

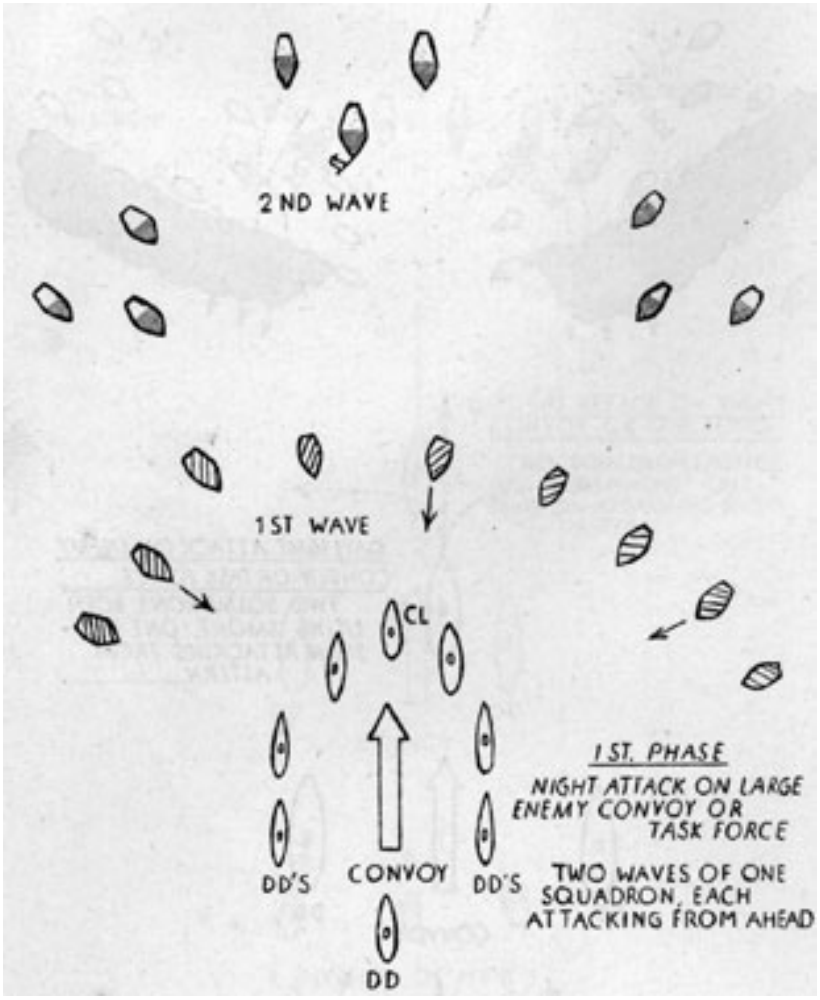
2ND WAVE
1ST WAVE
CL
DD'S
CONVOY
DD'S
DD
1ST. PHASE
NIGHT ATTACK ON LARGE ENEMY CONVOY OR TASK FORCE
TWO WAVES OF ONE SQUADRON, EACH ATTACKING FROM AHEAD

FIGURE 18.

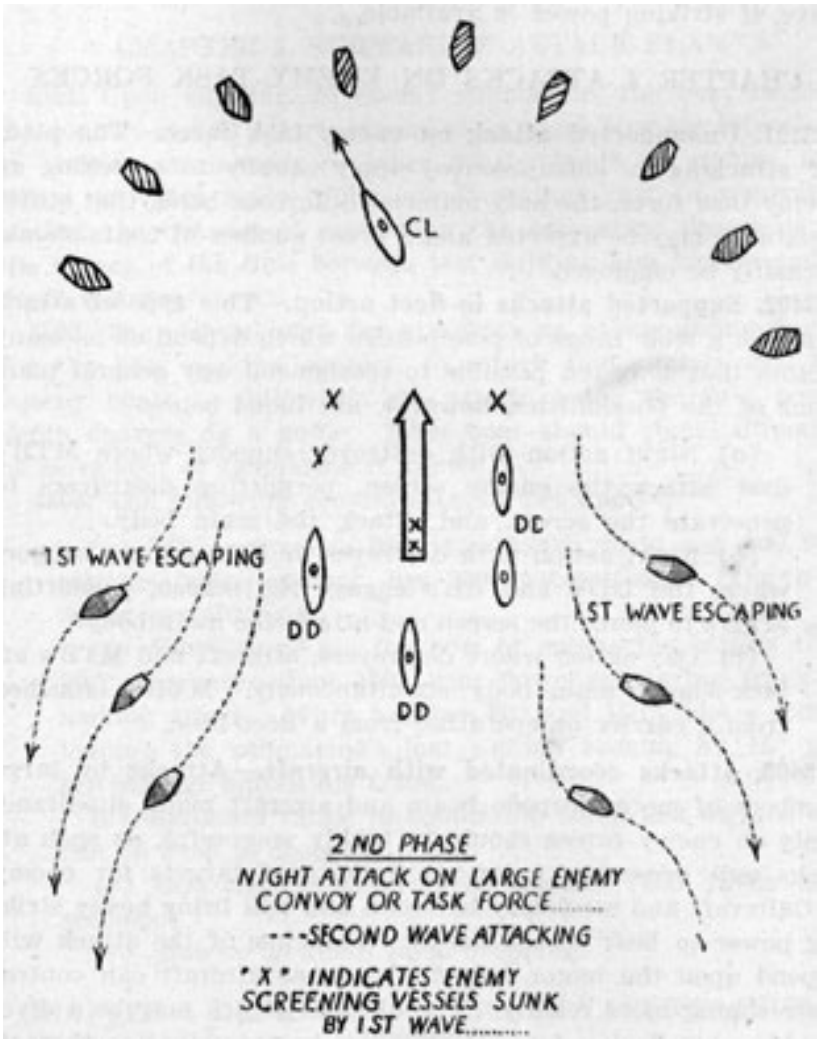

FIGURE 19.

first wave's attack is followed by a second wave which should try to attack at such a time as to take advantage of holes in the screen and enemy confusion caused by the first wave. If sufficient boats are available, a third wave may follow the second wave in attacking. First wave may renew the attack after last wave, if striking power is available.

CHAPTER 4. ATTACKS ON ENEMY TASK FORCES

3401. Unsupported attack on enemy task force.-The plans for attacking an enemy convoy apply equally to attacking an enemy task force, the only material difference being that stiffer resistance may be expected and a great number of boats should normally be employed.

3402. Supported attacks in fleet action.-This type of attack has such a wide range of possibilities which depend on so many factors that it is not possible to recommend any general plan. Some of the possibilities, however, are listed below.

(*a*) Night action with destroyer support where MTB's first attack the enemy screen, permitting destroyers to penetrate the screen and attack the - main body.

(*b*) Night action with destroyer or light cruiser support where the DD's and CL's engage the screen, permitting MTB's to pierce the screen and attack the main body.

(*c*) Day action where destroyers, aircraft and MTB's attack enemy main body simultaneously. MTB's launched from a carrier or operating from a fleet base.

3403. Attacks coordinated with aircraft.-Attacks by large numbers of motor torpedo boats and aircraft made simultaneously on enemy forces should be highly successful, as such attacks will present a great multiplicity of targets for enemy antiaircraft and secondary batteries and will bring heavy striking power to bear on the enemy. The time of the attack will depend upon the motor torpedo boats, as aircraft can control their timing more readily. The aircraft attack may be a dive-bombing, strafing, or torpedo attack or any combination thereof. An aircraft torpedo attack, coordinated, should be made on opposite side from the MTB attack. A high altitude horizontal bombing attack will not divide the enemy's fire to the maximum extent, as he will not divert the use of his machine guns toward the bombers.

In this type of attack all available motor torpedo boats should attack simultaneously.

3404. Use of aircraft parachute flares at night.-At night parachute flares dropped by aircraft on the opposite side of the enemy from approaching motor torpedo boats, would be very useful. These flares would attract the enemy's attention and would also silhouette him.

CHAPTER 5. SUBMARINE ATTACK PLAN

3501. Upon sighting an enemy submarine, the boat making the contact should attack immediately, signalling his intentions to division commander or other nearby boats by gunfire, flag signal or voice radio. The one important fact to remember is that the chances of destroying the submarine decreases as the square of the time between last sighting him and dropping depth charges.

3502. The general plan for attacking an enemy submarine is for the boat making contact, to attack immediately and for nearby boats to follow up the attack, using the first boat's depth charges as a guide. First boat should signal direction of movement of submarine if known.

3503. The following general attack rules apply: (*a*) When range is less than 1,000 yards, use 100 foot settings, when greater, use 200 foot settings. (Depth of water permitting.)

(*b*) When angle on the bow of submarine is less than 30° or greater than 150°, run down submarine track in making attack. When between 30° and 150° take a course leading the submarine's last sighted bearing by 15° and lay barrage across his track.

(*c*) Estimate range to submarine when last sighted and run on time to dropping point.

(*b*) Best attack speed is 36 knots. (100 yards in 5 seconds.)

(*e*) Slow to 20 knots when dropping.

CHAPTER 6. DEFENSE AND ESCAPE TACTICS-SMOKE SCREENS

3901. Avoiding detection.-The subject of avoiding detection has already been covered in part 1 of this publication. Once detected, motor torpedo boats must maneuver at high speeds, using smoke or any other means available, to successfully carry out their mission and avoid enemy gunfire or bombs.

3902 (a). Attack on, and defense from enemy surface vessels.-During daylight torpedo attacks, when sighted and fired

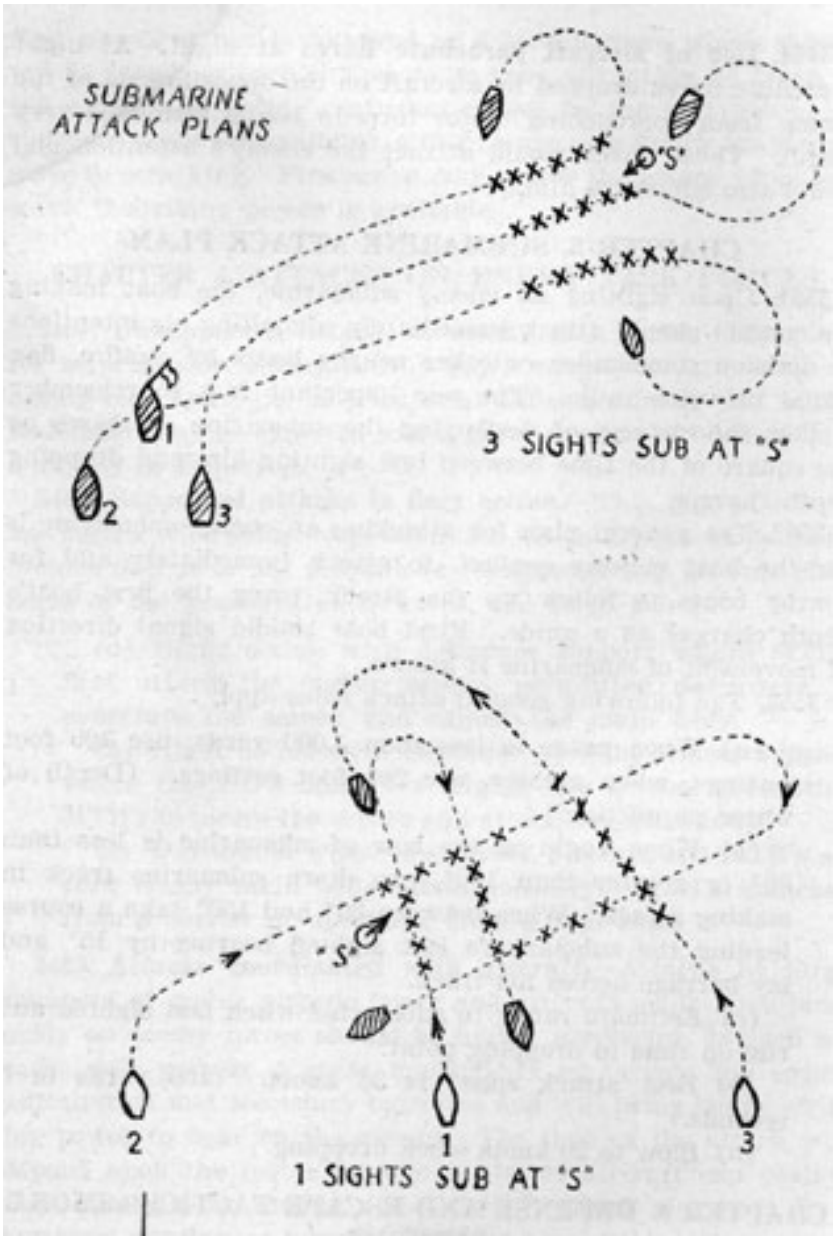

FIGURE 20.

NOTE.-(*a*) 1 sights sub at S and attacks with two barrages (8 charges).
(*b*) 2 attacks next with one barrage (4 charges).
(*c*) 3 attacks after 2's first barrage with about 6 charges.
(*d*) 2 and 3 lay remainder of charges if sub broaches or other evidence indicates his presence.

upon by enemy surface vessels, a dispersion of boats should be made in order to present a multiplicity of targets. For example, if the division is in a normal deployment formation, boats should spread to about 300-500 yards distance, maintaining, if practicable, the same bearing on the leader. Attack plans should provide for a dispersion of divisions if several divisions are used in an attack, so the attack will be conducted with divisions approaching from different directions. This not only presents the enemy with smaller targets but gives him a greater number, thus rendering a difficult fire control problem. If the enemy uses barrage fire from guns larger than machine guns, zigzagging on the approach may be necessary with reasonable long and irregular runs to right and left of the base torpedo course. When within machine gun range, short zigzag courses should be used. Unless the enemy's fire is extremely accurate and salvos are falling close, zigzagging should not be resorted to as it slows down the approach considerably and increases the time in reaching the firing point thus permitting the enemy more time in solving the fire control problem. Each individual boat commander will be the best judge as to when it is necessary to zigzag to avoid destruction.

3902 (b). Normal retirement and escape.-Upon completion of the torpedo attack, opportunities may be had to continue closing the range and attack with machine guns, hand grenades or depth charges. In any case after completion of all attacks made by the division deployed in the normal manner, all boats should escape directly away from the enemy on divergent courses, covering the escape with smoke. The retirements should be made by vessels turning away from the center of the formation. In case of a three boat division, the center boat may turn either way.

3903. Defense from enemy aircraft-scatter plan.-The best defense against large numbers of enemy aircraft, when the enemy has definite air superiority, is not to have MTB's exposed to attack during daylight. Motor torpedo boats on such occasions should be well scattered and hidden and likewise their repair facilities and spare parts. However, if the division (while underway) is suddenly attacked by a small number of enemy aircraft (two or three) generally the best defense is to proceed at maximum speed and scatter in the V formation, with about 300-500 yards between boats. This gives the maximum mutual support to each other. A heavy volume of gun fire

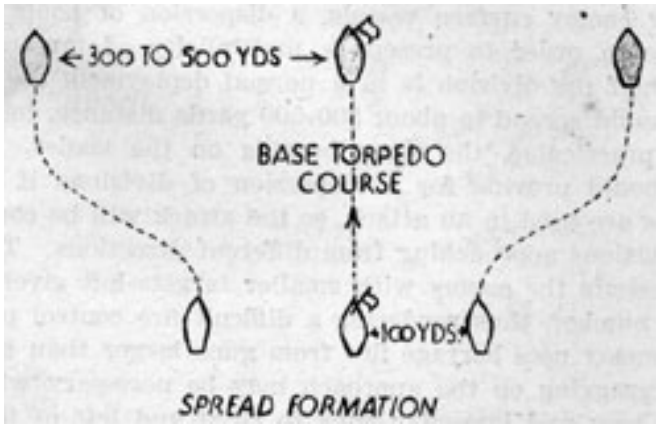

FIGURE 21.

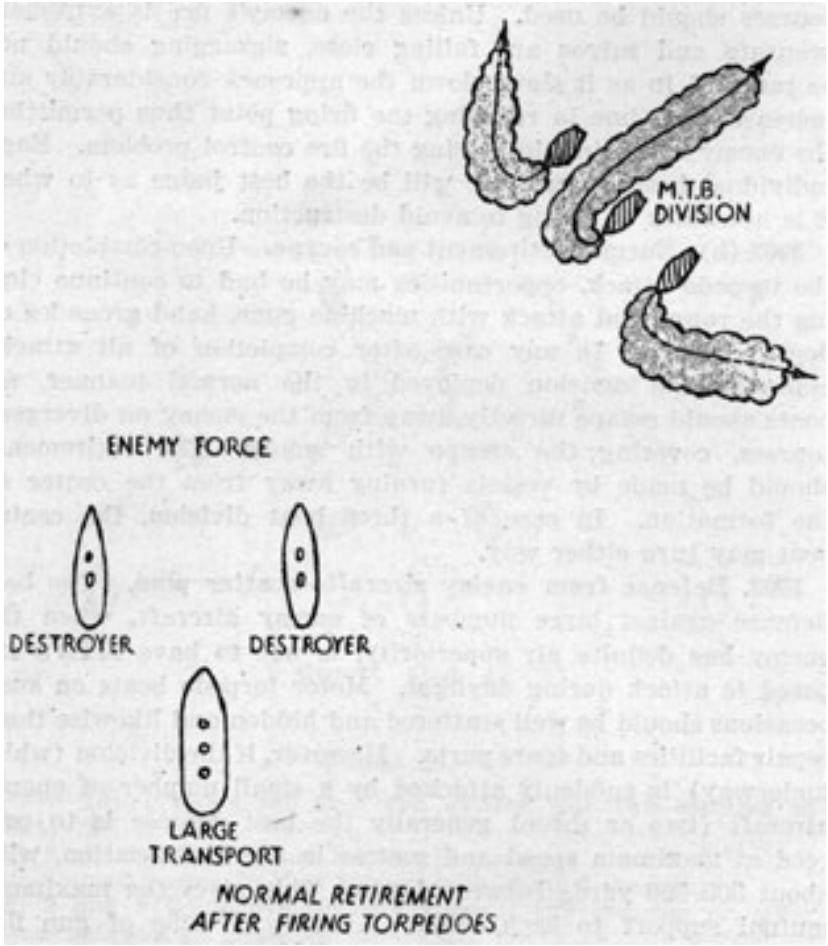

FIGURE 22.

should be brought to bear when the aircraft are within gun range: Defense tactics employed, will to a large degree, depend ups, the type of aircraft attacking. The following maneuvers will probably be most effective against the attacks as indicated:

(*a*) Attacked by dive bombers-attempt to turn under them using maximum speed.
(*b*) Attacked by horizontal bombers-90° changes of course at, high speed.
(*c*) Straffing attacks-use high speeds running across and slightly toward their line of attack. Avoid being raked from ahead or astern.

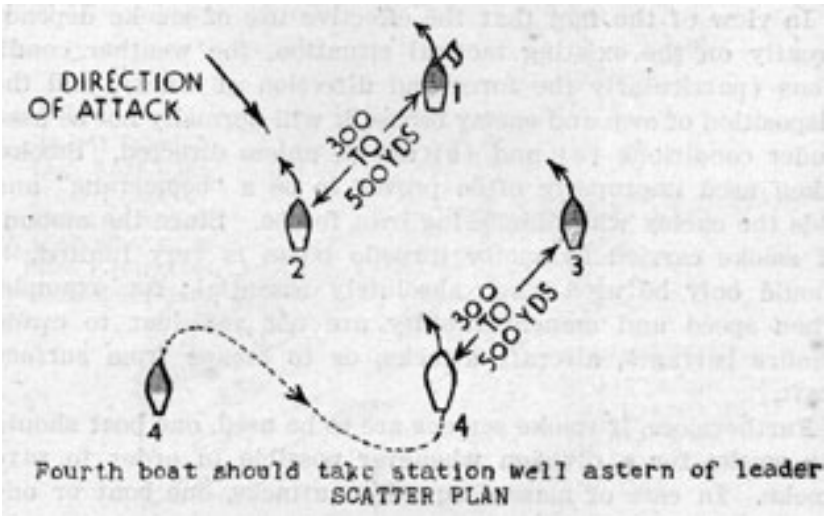

FIGURE 23.

During hazy or cloudy weather conditions, MTB's may often conceal themselves from aircraft by stopping and lying to. The wakes made by motor torpedo boats are normally more readily detected from the air or surface than the boats themselves.

If MTB's are attacked by large numbers of enemy aircraft, they should scatter in the normal manner and conceal themselves with smoke. (See art. 3904, example No. 3.)

High altitude bombing attacks on MTB's will probably not be attempted or if they are they will undoubtedly be ineffective.

3904. Smoke screens.-The most difficult, and yet very often the most effective, means of defense of motor torpedo boats is

the use of smoke screens. Smoke might be used effectively by motor torpedo boats under the following conditions.

(*a*) In making an approach for delivery of a long range daylight torpedo attack on surface craft and in retiring from such attack.

(*b*) In escaping after delivery of a short range torpedo attack at night when illuminated and being fired upon by enemy screening or other vessels.

(*c*) As a protection when being attacked by aircraft or pursued by enemy light forces.

(*d*) Under special circumstances to screen the movements of other vessels.

In view of the fact that the effective use of smoke depends greatly on the existing tactical situation, the weather conditions (particularly the force and direction of wind), and the disposition of own and enemy forces, it will normally not be used under conditions (a) and (b) above, unless directed. Smoke, when used improperly often proves to be a "boomerang" and aids the enemy while hindering own forces. Since the amount of smoke carried by motor torpedo boats is very limited, it should only be used when absolutely essential; for example, when speed and maneuverability are not sufficient to evade gunfire barrages, aircraft attacks, or to escape from surface craft.

Furthermore, if smoke screens are to be used, one boat should lay smoke for a division whenever possible in order to save smoke. In case of massed squadron attacks, one boat or one division might be able to lay smoke for a squadron under certain conditions.

The following examples are given wherein smoke might be effectively employed:

EXAMPLE No. 1

1. MTB's to deliver a torpedo attack on armed enemy surface vessels during daylight high visibility, unsupported by own surface craft. Initial position, course and speed of enemy has been given.

(*a*) If possible the MTB's should select a course to intercept the enemy well forward of the enemy's beam (angle on the bow between 300-60°) and so that on the approach to attack the wind will blow the screen toward the enemy. (See diagram below.)

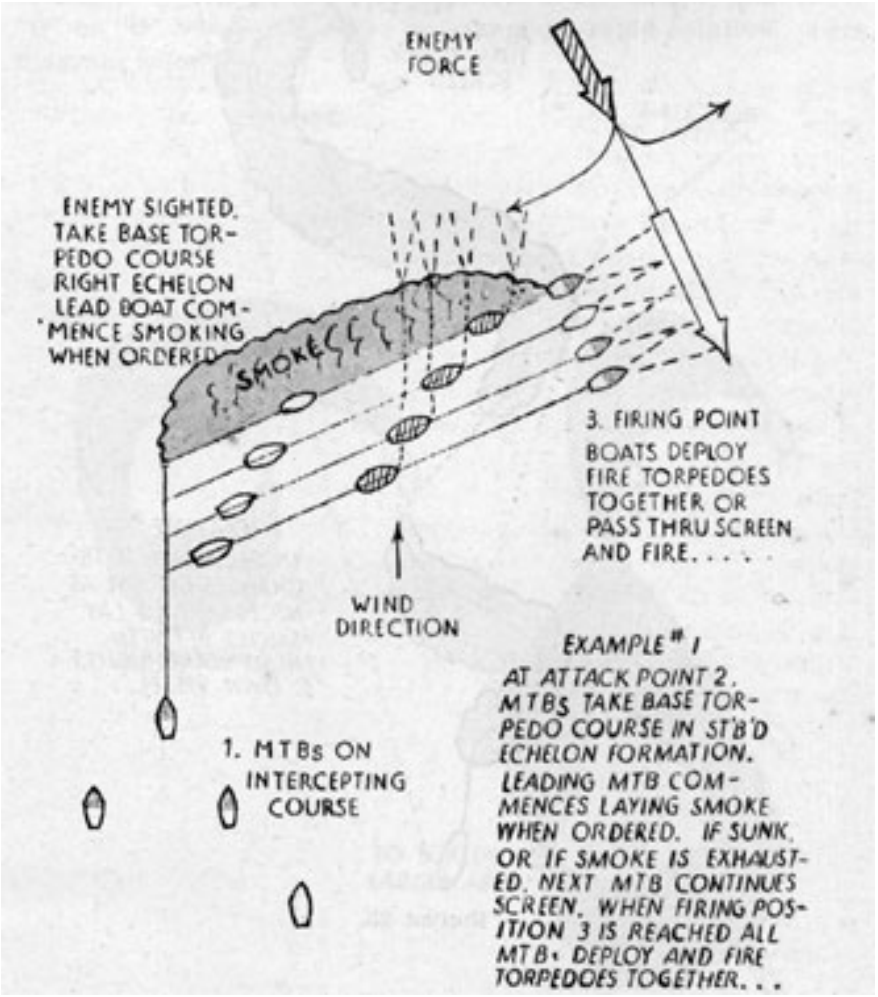

FIGURE 24.

EXAMPLE No. 2

2. At night MTB's in units of one or more attack enemy surface vessels with torpedoes and in escaping are illuminated and fired upon. (See diagram below.)

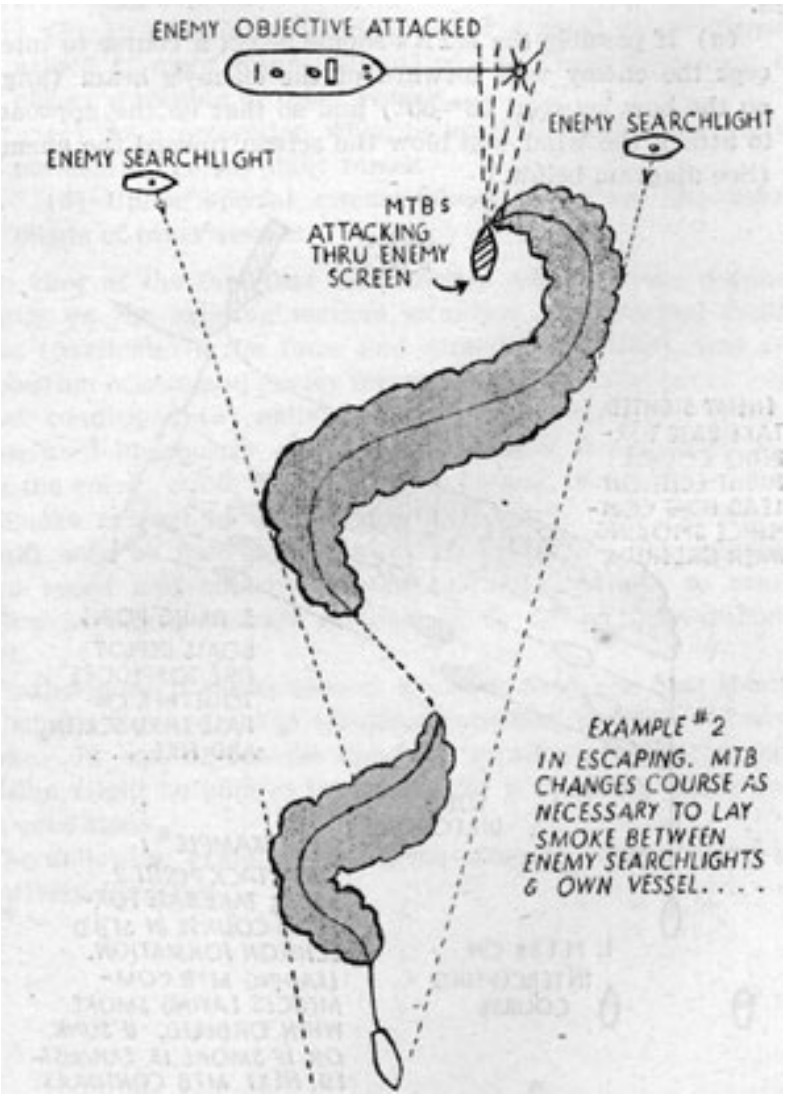

FIGURE 25.

EXAMPLE No. 3

3. While on patrol or other assigned operations, MTB's undergo repeated attacks by enemy aircraft and sustain or are likely to sustain severe damage. Under the above conditions it is desirable to lay a screen as rapidly as possible which will spread and permit the MTB to hide in the screen. If several vessels are to seek refuge in the same screen it is best to lay it over a larger area in an "S" or figure "8". When only a small area is covered, aircraft may drop fragmentation bombs using center of smoke as a point of aim and thus inflict possible damage. If only one boat is involved, a screen laid in a letter "0" or "G" would probably offer the most rapid solution. (See diagram below.)

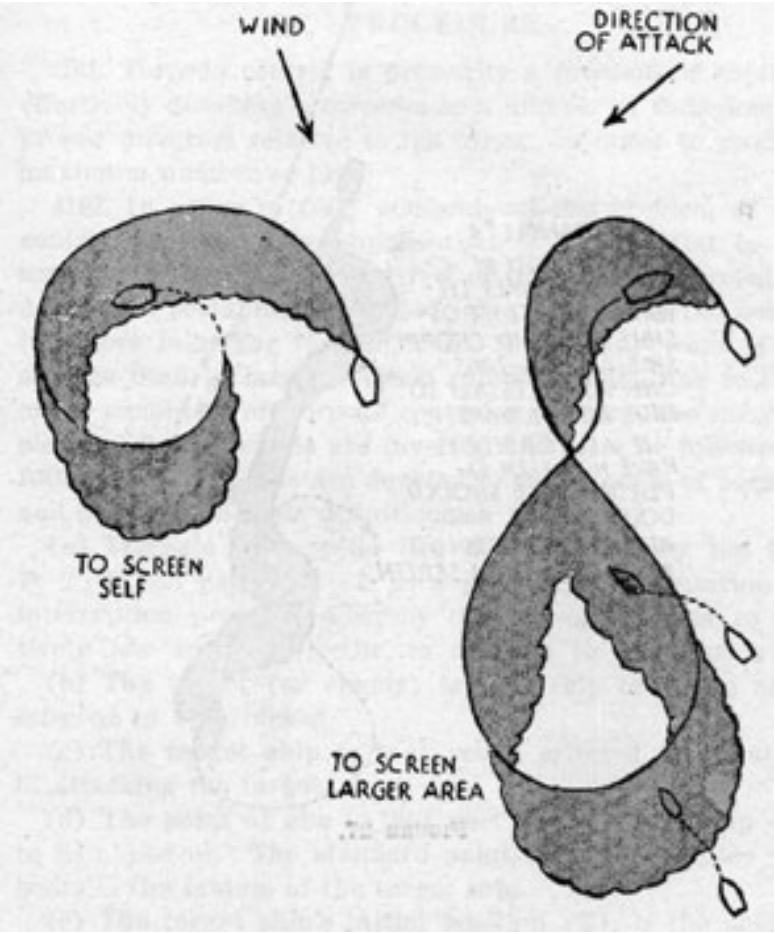

FIGURE 26.

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EXAMPLE No. 4

4. MTB is being pursued and fired upon by a destroyer.

(*a*) If possible in escaping select a course going with the wind, lay smoke.

(*b*) Use zigzag courses only as necessary to hide boat and wake. (See diagram below.)

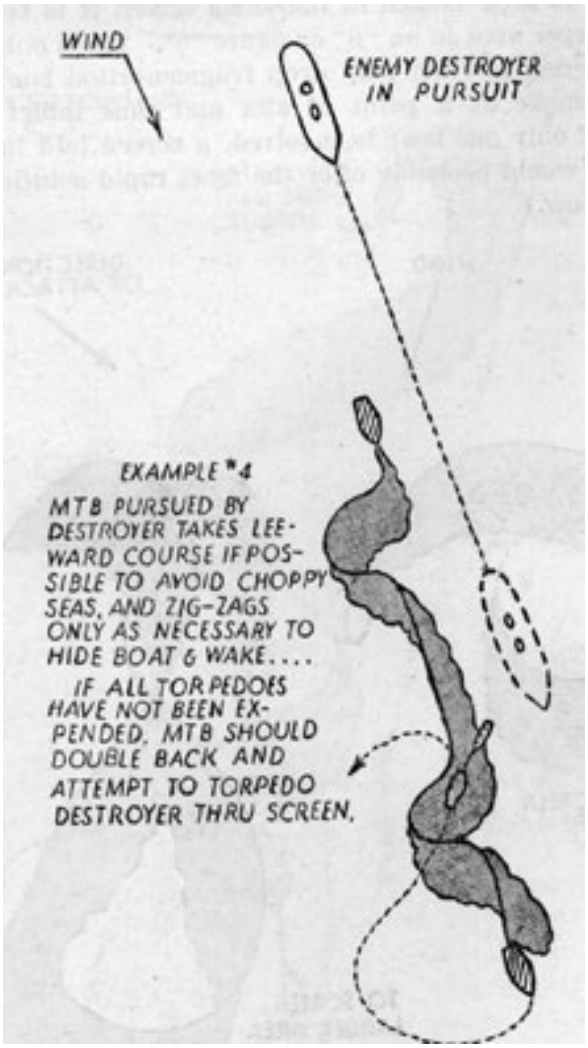

FIGURE 27.

Previous Part Doctrine Home Page Next Part

PART 4. ARMAMENT-DOCTRINES AND STANDARD PROCEDURES

CONTENTS

CHAPTER 1. TORPEDO CONTROL AND STANDARD PROCEDURE

4101. Torpedo control is primarily a problem of rapidly and effectively directing a torpedo, or a number of torpedoes, in the proper direction relative to the target, in order to produce the maximum number of hits.

4102. In order to fully comprehend the problem of- torpedo control and its proper application, it is essential to have a complete understanding of a few of the basic fundamentals and definitions pertaining to torpedo fire. Whereas the control of torpedoes in motor torpedo boats is in many ways relatively simpler than in larger torpedo carrying craft, due to the lack of, or simplicity of, torpedo control equipment, the same principles and fundamentals are involved and must be followed. The following paragraphs are devoted to the triangle of torpedo fire and some of the basic definitions.

(a) Triangle of torpedo fire is illustrated by the triangle F. T. H. on page 4-2. It is a graphic representation of the interception problem, whereby the torpedo likened to a relatively low speed projectile, is directed to intercept a target.

(b) The target (or enemy) is that ship or group of ships, selected to be attacked.

(c) The target ship is that vessel selected to be aimed at in attacking the target.

(d) The point of aim is that part of the target ship selected to be aimed at. The standard point of aim for motor torpedo boats is the middle of the target ship.

(e) The target ship's initial position (T), is the position of the target ship when the torpedo is fired.

(f) The target ship track (TY), is the line along which the target ship is proceeding through the water, when the torpedo is fired.

(g) The actual target speed is the target ship's speed through the water.

(h) The line of sight (FT) is the line from the firing point to the target ship's initial position. It is the direction of the point of aim from the firing ship, when the torpedo is fired.

(i) The firing point (F) is where the torpedo starts its run. Broadly, it is the position of the firing ship when the torpedo is fired.

(j) The target angle (HTF) is the relative bearing of the firing ship from the target ship, measured clockwise from the target ship's head to the line of sight from 0° to 360°.

(k) Angle on the bow. This term is more commonly used in MTB. torpedo fire than target angle. It differs from target angle only in that it is measured to the **right** or **left** from the target ships head to the line of sight, and its limits are 0° to 180°. When the target is maintaining a constant heading, target angle or angle on the bow and true target bearing, change at the same rate. Target angle and angle on the bow, therefore, should be identified by the time of observation or by an event related to time, such as moment of firing.

(l) The torpedo track (FR) is the path along which the torpedo proceeds through the water.

(m) The torpedo speed is the speed made good through the water by the torpedo, while covering its designed range. It is assumed to be constant.

(n) The point of intercept (H) is the point at which the torpedo track intersects the target ship's track.

(o) The track angle (YHF) is the angle at the point of intercept between the target ship's track and reversed direction of the torpedo track. It is measured clockwise from the target ship's head to the torpedo track, from 0° to 360°. The track angle is important in that it determines the amount of target ship length presented to the oncoming torpedo. An attractive track angle is one near 90° or 270° where the maximum amount of target area is presented to the oncoming torpedo and the maximum target maneuver, will be necessary for the target to avoid it.

(p) The sight angle (TPM and TFH) is the angle at which the torpedo must depart, relative to the line of sight, in order to intercept a target ship which is proceeding steadily along an assumed course at an assumed speed. The term **momentary sight angle** is sometimes used to describe the sight angle used in firing. Sight angle is **measured clockwise from the line of sight to the mean torpedo track from 0° to 360°**. When the torpedo track will lie to the right of the line of sight, the sight angle will lie between 0°

and 90°. When the torpedo track will lie to the left of the line of sight, the sight angle will lie between 360° and 270°. Theoretically the sight angle can have an angular value as great as 90° (sight angles of 90° and 270°) but, for battleship targets, would seldom exceed 45° and 315°. The largest sight angle to intercept a given target is encountered when the target angle is 90° (or 270°).

In practice, sight angle is usually obtained by a "solution" of the triangle of torpedo fire, using a torpedo director, an

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angle solver, or by estimation. The torpedo control officer must know, or estimate, the target course or target angle and the actual target speed.

The geometry of a graphic solution is illustrated in figure 1, as follows: The line of sight is laid down, then the target track is cut in, either as a true course or by laying off the target angle. To a convenient scale, the actual target speed is laid off from the target ship's initial position, to some point such as M. From M an arc having a radius to the same scale, equal to the torpedo speed, is swung so as to cut the line of sight, as at P. In the small triangle, TPM is the sight angle. The torpedo track is cut in, from the firing point, parallel to the line PM. This locates the point of intercept. The angle TFH is therefore also the sight angle, by construction.

Torpedo directing is simply a problem in intercepting. From M draw the line MN, parallel to the line of sight. It will mark off the distance FN which is by construction, equal to PM. In other words, when the target ship has advanced to M, the torpedo will be at N. The angle MNH is still the sight angle and the torpedo has the target ship on a constant bearing which is the sight angle. Thus, the torpedo is on a collision course with the target ship. (From the target ship's point of view, the torpedo which will hit it, is also on a constant bearing which is the angle on the bow, not the track angle.)

(q) Lead angle or angle of lead. This term is more commonly used in MTB torpedo fire than sight angle and differs only in that it is measured right or left of the line of sight to the mean torpedo track. Its theoretical limits are from 0° to 180°, however, practical lead angles usually are never greater than 60°.

(r) Range, as in gunnery, is the distance of the target ship from the firing ship at any given moment. It is usually expressed in yards.

(s) The firing range (FT) is the range to the target at the instant the torpedo is fired.

(t) The effective range (FK) is the maximum firing range at which a torpedo, while running at its designed speed, will just reach the point of intercept.

Effective range varies with the shape of the triangle of torpedo fire.

(u) The effective range factor is the ratio of effective range to torpedo range. In the sketch it equals **FK/ FL**. The effective

range factor for each set-up can be obtained from the Mark 7 angle solver, at the same time the sight angle is obtained.

With a small track angle (one near 0°) the effective range will exceed the torpedo range because the target advances toward the torpedo. On the other hand, with a large track angle, the effective range becomes less than the torpedo range, because the torpedo must make a stern chase. Target speed affects effective range, because the component of the target ship run is added to or subtracted from the torpedo range.

(v) The range allowance (TK) equals effective range minus firing range. It is a margin allowed in order to insure that the torpedo run shall be less than the torpedo range.

The range allowance provides against the torpedo's falling short due to control errors and in some degrees, to target maneuvers. The particular control errors it is intended to cover are a too low estimate of the firing range and an error "toward" in estimating the course of the target ship. In motor torpedo boats a range allowance of at least 4,000 yards should be used in long range torpedo fire

(w) Torpedo range (FL) is the normal distance which the torpedo will run at its designed speed. For Mark 8-3C and 3D torpedoes, it is 13,500 yards.

(x) Over range (LR) is the distance the torpedo runs beyond torpedo range. This distance is run at reduced speed and with uncertain performance.

(y) Linear target presentment is the virtual width, in yards, that a given target length presents to torpedoes advancing from a given direction relative to the target's track. In other words, it is the distance, normal to the mean torpedo track, that separates the extreme right hand and left hand torpedo tracks which would just intercept the respective ends of the target.

(z) Base torpedo course is the true direction of the mean torpedo course expressed in degree.

4104. Salvo fire.

(a) A torpedo salvo is a number of torpedoes, directed at the same target fired closely enough together, to constitute a simultaneous menace. Single ship salvo-one fired by one vessel. Group salvo-is composed of several single ship salvos. Section, division, and squadron salvos are forms of group salvos.

(b) Full salvo of torpedoes in motor torpedo boats, is a salvo comprised of all torpedoes normally carried

on board.

(c) Partial salvo of torpedoes in motor torpedo boats, is a salvo comprised of part of the torpedoes on board.

(d) Mean torpedo track is the average as regards both direction and position of the tracks of the different torpedoes comprising the salvo, assuming all runs normal. It indicates the basic direction of the salvos.

4105. Time elements in firing torpedoes.-

(a) The firing interval of a torpedo is the time interval between the control officer's mental decision to fire and the instant the torpedo takes the water. For electric firing this interval should not average more than 1.5 seconds. All electric firings should be paralleled by emergency percussion firings.

(b) Emergency percussion firing is when personnel stationed at the tubes, strike the torpedo impulse chamber firing pin with a mallet, upon the order to fire torpedoes. It should be standard practice to use this method of firing, whether electrical firing circuits are working or not.

(c) The salvo interval is the time interval between successive discharges which comprise the salvo or the time interval between launching first and last torpedoes of a salvo. Salvos of torpedoes are separated into discharges in order to reduce the chance of torpedoes colliding with each other near the firing point. In boats carrying four torpedoes with two on each side, after torpedoes should be discharged before the forward ones if all four torpedoes are to be fired in the same salvo. In firing all four torpedoes, at least five seconds should elapse between discharge of the after pair, and discharge of the forward pair.

4106. Spread and gyro angles.-

(a) A spread is a number of torpedoes fired on divergent courses or on parallel courses. If fired on divergent courses, the torpedoes cover a front which increases in width with length of torpedo run. If fired on parallel courses, the torpedoes are launched at intervals of time, in order to form the spread, and the front remains at a fixed value determined by the spacing at the time of firing. The term "spread" may be expressed in degrees, as a 20° spread. The basic purposes of spreads are to compensate for errors in estimating target course and speed, and to counteract target maneuvers (using the shotgun method instead of the rifle).

(b) The unit of spread is the angle separating the tracks of adjacent torpedoes in a single-ship spread. It equals the

amount of spread divided by one less than the number of torpedoes comprising the spread.

(c) Gyro angle is an angle applied in the mechanism of a torpedo gyro before firing. The torpedo, immediately upon launching, turns through this angle and straightens out on a course which differs by the amount of that angle from the direction of the torpedo tube at the moment of firing. Gyro angles set on torpedoes fired from motor torpedo boats are usually small and only sufficient to compensate for tube angles used and to provide for a small spread. Gyro angle is referred to the axis of the torpedo, or what is the same thing, to axis of the tube. It is measured from 0° clockwise through 360°. In motor torpedo boats, gyro angles are referred to as so many degrees **right** or **left** i. e., the number of degrees, and direction the torpedo turns through, after leaving the tube.

(d) A spread gyro angle is a small difference between the gyro angles of adjacent torpedoes. It causes these torpedoes, when fired in a salvo, to diverge by the amount of the difference. The primary purpose is to secure accurate torpedo distribution in a spread, but a secondary purpose of considerable practical importance, is to reduce the prospect of torpedo collisions near the firing point.

(e) The basic gyro angle is the average of the gyro angles of a salvo of torpedoes at the instant of firing. It is the reference gyro angle. -

4107. Tube angles.-

(a) Tube angle is defined as the angle relative to the firing ships head at which a tube mount is trained. It is measured clockwise from the firing ships head to the axis of the torpedo tube, from 0° to 360°. In motor torpedo boats the tubes are normally fixed-that is, they may be trained out a small amount to permit the torpedo to clear the boats side, and then they are secured in that position. Except when the probability of firing torpedoes exists, the tubes are trained in, and secured. The amount that the tube can be trained out, depends on the design of the boat. When four torpedo tubes are carried, the tube train angle limits, of after tubes, usually differ from the forward tubes by a few degrees, in order to permit after torpedoes when launched, to clear forward tubes. In motor torpedo boats the tube angles are customarily referred to as so many degrees right or left of the centerline of the boat.

(b) Standard tube angles, gyro angles and spreads. The following table gives the tube train angles, gyro angles,

resultant unit of spread, and total spread for the PT 20 type of bow launching motor torpedo boats. (See page 4-9 for illustration.)

Tube No.	Tube train angle	Gyro angle	Unit of spread	Total spread
Forward starboard No. 1	8 1/2 ° R	8° L	1°	--
Forward port No. 2	8 1/2° L 351 1/2°	8° R 352°	1°	3°
Aft starboard No. 3	12 1/2° R	11° L	1°	--
Aft port No. 4	12 1/2° L347 1/2°	11°R349°	1°	--

(c) Gyro angles are normally set on the torpedoes before they are placed in the tubes. These settings should be carefully checked by an officer to see that the settings are in the right direction and correspond to the standard setting for the particular tube the torpedo is loaded into.

4108. Firing definitions.-

(a) Curved fire is any method of fire using gyro angles. The type of firing used in motor torpedo boats is curved fire ahead, with tube angles fixed. The torpedoes are than directed by conning the ship to the desired base torpedo course.

(b) Curved fire ahead is a form of curved fire in which the mean torpedo track lies along or close to the firing ship's heading, at the moment of firing. This method permits all torpedoes on board to be discharged in a single salvo.

(c) Single firing is the firing of only one torpedo at a time. When two torpedoes on the same side are to be discharged in a Salvo, five seconds should elapse between successive discharges, and the after torpedo should always be discharged first.

(d) Pair firing is the simultaneous firing of one torpedo from each of two or more tubes. In motor torpedo boats pair firing will consist of the firing of one torpedo from each of two opposite tube mounts at the same time. In other words, firing the starboard and port after torpedoes simultaneously, and then the starboard and port forward torpedoes simultaneously. In this case five seconds should elapse between the discharge of after and forward torpedoes.

4109. Torpedo control system.-

(a) Torpedo director. (See illustration on page 4-12.) This is a practical and simple director which has been used in some

squadrons. It solves the triangle of torpedo fire by mechanical means, when properly set up. It consists of two arms, one representing target track and the other representing torpedo track.

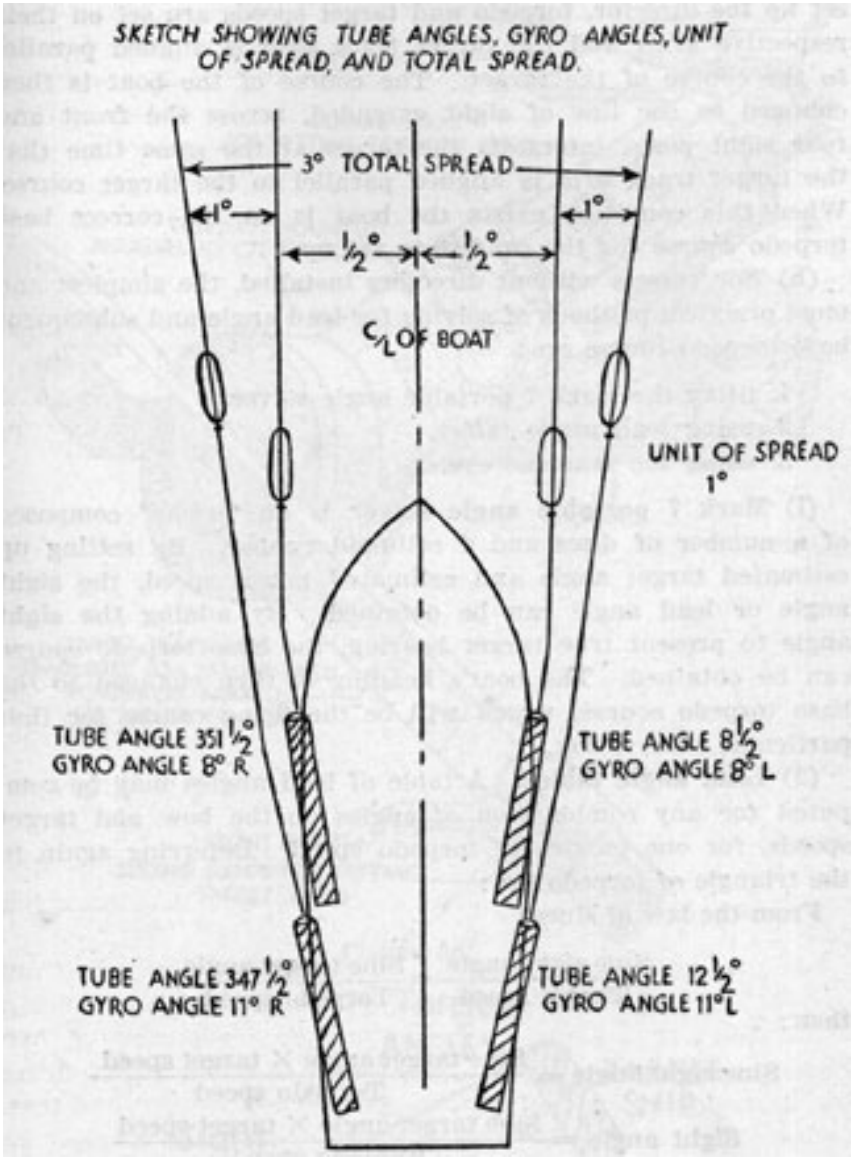

FIGURE 29.

The target track arm is graduated for target speed and is rotatable relative to the torpedo track arm. The target track arm carries a sliding block on which a front sight is mounted. The torpedo track arm is made in two parts, one

part of this arm is graduated for torpedo speed, carries the rear sight, and slides in and out of the other part, which is stationary. The stationary part of this torpedo track arm is mounted along or parallel to the center line of the boat. To set up the director, torpedo and target speeds are set on their respective arms and the target track arm is aligned parallel to the course of the target. The course of the boat is then changed so the line of sight extended, across the front and rear sight posts, intersects the target at the same time that the target track arm is aligned parallel to the target course. When this condition exists the boat is on the correct base torpedo course for the conditions set up.

(b) For vessels without directors installed, the simplest and most practical methods of solving for lead angle and subsequent base torpedo course are:

1. using the Mark 7 portable angle solver.
2. using lead angle tables.
3. using the seamans eye.

(1) Mark 7 portable angle solver is an "izwas" composed of a number of discs and a celluloid runner. By setting up estimated target angle and estimated target speed, the sight angle or lead angle can be obtained. By adding the sight angle to present true target bearing, the base torpedo course can be obtained. The boat's heading is then changed to the base torpedo course, which will be the firing course for that particular observation.

(2) Lead angle tables. A table of lead angles may be computed for any combination of angles on the bow and target speeds, for one particular torpedo speed. Referring again to the triangle of torpedo fire:

From the law of sines:

(Sine sight angle / Target speed) = (Sine target angle / Torpedo speed)

then:

Sine sight angle = (Sine target angle X target speed) / Torpedo speed

Sight angle = (Sine target angle X target speed) / Torpedo speed

If torpedo speed is constant, different values may be substituted in above formula for target angles and target speeds and a table of sight angles computed. By using this table, in conjunction with relative bearing marks painted every 5° or

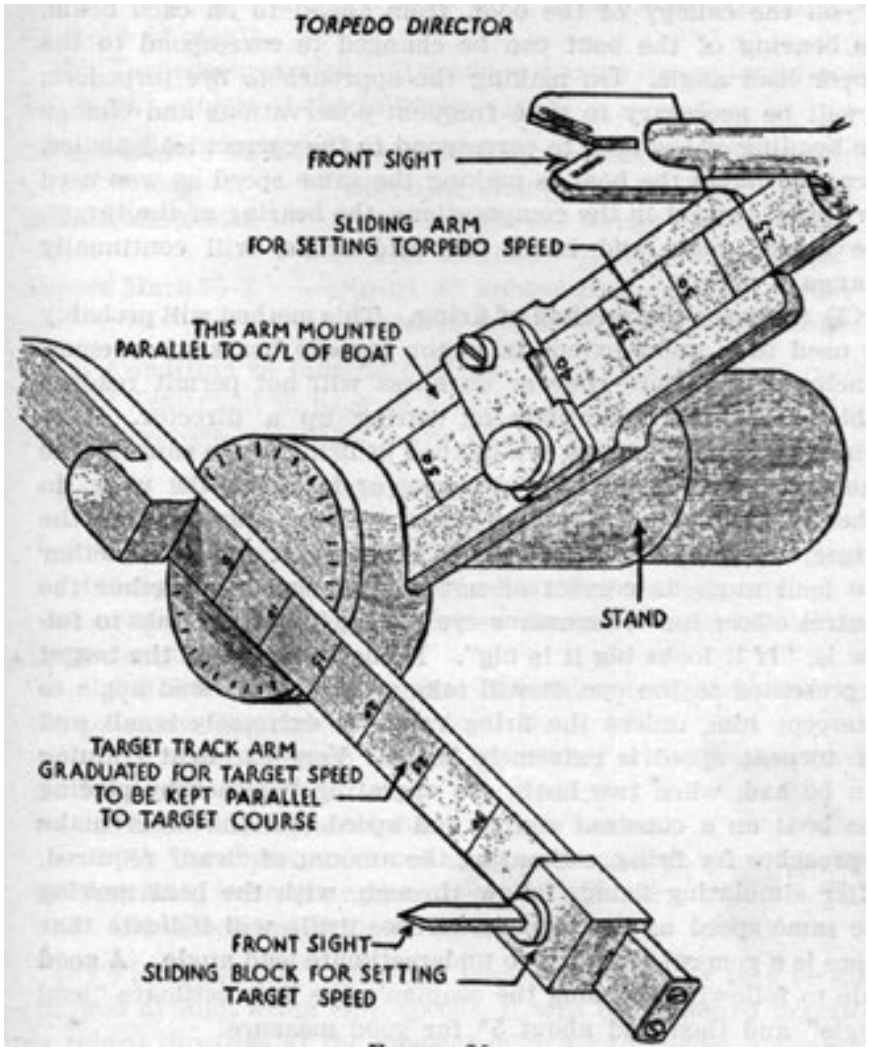

FIGURE 30.

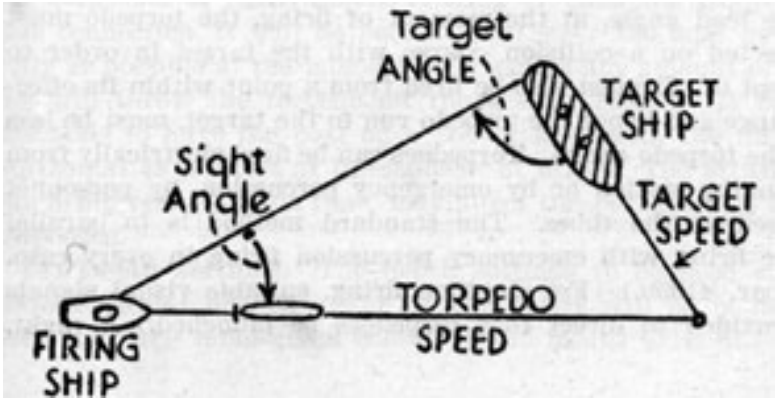

FIGURE 31.

10° on the canopy of the boat, from ahead to on each beam, the bearing of the boat can be changed to correspond to the proper lead angle. On making the approach to fire torpedoes, it will be necessary to take frequent observations and change the heading of the boat to correspond to the correct lead angles, because, unless the boat is making the same speed as was used for torpedo speed in the computations, the bearing of the target, the target angle and hence the lead angle, will continually change.

(3) Seamans eye method of firing. This method will probably be used to a great extent in motor torpedo boats when emergencies arise where time or darkness will not permit reading tables, making calculations or setting up a director. The principle of the seamans eye method of firing is the same as the hunter uses when he fires at ducks or birds on the wing, in other words leading a moving target. The amount to lead the target will depend on the target's course and speed. Whether the lead angle is correct or not will depend on whether the control officer has a "seamans eye". In general the rule to follow is, "If it looks big it is big". If the full area of the target is presented to the eye, it will take a substantial lead angle to intercept him, unless the firing range is extremely small and the torpedo speed is extremely large. Very excellent training can be had, when two boats are operating together by placing one boat on a constant course and speed and the other make! approaches for firing, estimating the amount of "lead" required. After simulating firing, follow through, with the boat making the same speed as the torpedo. These drills will indicate that there is a general tendency to underestimate lead angle. A good rule to following in using the seaman's eye is to estimate "lead angle" and then add about 5° for good measure.

4110 (a). Methods of firing.-Whatever the method of solving for the lead angle, at the moment of firing, the torpedo must be directed on a collision course with the target in order to intercept it. It must also be fired from a point within its effective range and hence the torpedo run to the target, must be less than the torpedo range. Torpedoes can be fired electrically from the conning station or by emergency percussion, by personnel stationed at the tubes. The standard method is to parallel electric firing with emergency percussion firing in every case. (See par. 4105b.) For daytime firing, suitable visual signals are provided to direct that torpedoes be launched. A night,

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the firing of, and number to be fired, will usually be directed by word of mouth.

(b) Torpedoes carried. Torpedoes carried on motor torpedo boats will consist of the following types:

21-inch Mark 8-3C & D	Speed 27 knots-Range 13,500 yards. Speed 32 knots-Range 9,000 yards.
21-inch Mark 14-1	Speed 46 knots-Range 4,500 yards. Speed 28 knots-Range 15,000 yards.
21-inch Mark 15-1	Speed 35 knots-Range 10,000 yards. Speed 46 knots-Range 6,500 yards.

(c) Condition to torpedo battery. (See Conditions of readiness of armament in back of book.) At the time of tiring torpedoes the battery will be in the following state of readiness:

(1) Torpedoes properly loaded in tubes in the fully ready condition, proper depth and gyro angles set.
(2) Tubes trained out to maximum position and secured to stops. Tubes in all respects clear and ready for firing.
(3) Primed and dry impulse charges loaded in the impulse chambers.
(4) Firing pins in impulse chambers in contact with impulse charge primers.
(5) Tube tripping latches in contact with torpedo starting levers.
(6) Boat headed on base torpedo course.
(7) Personnel stationed at tube mounts to parallel electric firing with emergency percussion firing.
(8) Electrical firing circuit closed.

(d) Firing speeds. Although torpedoes normally may be discharged at high firing ship speeds, it will be standard practice to retard throttles at the moment of firing torpedoes and allow the torpedoes to clear, before retiring or changing course. In this connection, it will be necessary to steer the boat as carefully as possible at the moment of firing, as any amount of yawing will throw the torpedo off the desired course. It is also desirable to have the boat on a steady keel, with the tubes as horizontal as possible at the moment of firing. The attitude of the firing vessel at this time, may affect the performance of the torpedoes.

(e) Depth settings. The depth settings to be used on torpedoes carried aboard motor torpedo boats will be in accordance with the table given below. If no means exist of setting

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torpedoes for depth after they are in the tubes, the settings should be staggered on the individual torpedoes on board, between 14 and 18 feet. These settings are prescribed for a mechanical type warhead exploder only.

Depth settings

Battle cruisers, battleships, aircraft carriers	Heavy cruisers, light cruisers, large auxiliaries, submarines	Destroyers, small auxiliaries
Forward tubes, 18 feet	16 feet	12 feet.
After tubes, 20 feet	14 feet	10 feet.

4111. Torpedo control procedure.-

(a) With tubes trained out on each side of the boat and with gyro angles set as prescribed in art. 4107b, the

torpedoes, when fired in the proper manner will form a symmetrical salvo. (See page 4-9.) The boat when on the proper firing course will be headed down the mean torpedo track of the salvo. As previously stated, in a standard 4 torpedo salvo, one torpedo from each **after** tube is fired simultaneously and five seconds later, one torpedo from each **forward** tube is fired simultaneously. Extreme care must be used in conning the boat during the period of firing.

(b) Primary method.

(1) Boat captain or control officer orders "stand by to fire torpedoes-Full salvo or tube No. ____ ," and heads boat on approximate collision course.

(2) Boat captain then places boat on proper heading which is base torpedo (firing) course, by means of director, lead angles or seamans eye.

(3) Torpedoman checks tripping latch, firing pins, etc., to see if tubes and torpedoes are in all respects ready, then reports "battery or tube ____ ready."

(4) Torpedoman and one engineering rating stand by torpedo tubes for emergency percussion firing.

(5) Boat captain or control officer orders "fire torpedoes or fire tube No. ____" making appropriate arm signal, and retards throttles.

(6) Boat captain or control officer closes electrical firing circuits using care to fire after torpedoes first.

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(7) Tube personnel use emergency percussion firing methods on all tubes designated to fire, taking care to fire those in after tubes first, unless otherwise designated.

(8) After torpedoes are clear, increase speed and retire, unless otherwise directed.

(c) Emergency method. Under certain conditions rapid action will be required and time may not permit many orders to be issued or an accurate base torpedo course to be calculated. It is also possible that all personnel will be required to man and fire guns and no one will be available to stand by the tubes. In this case the boat captain should swing the boat to an approximate base torpedo course by seamans eye and fire torpedoes immediately by electricity. If the primers fail to fire, any one available should be directed to use emergency percussion methods to get them out.

CHAPTER 2. GUNNERY ORDERS AND STANDARD PROCEDURE

4201. Personnel, training and safety precautions.-Each member of a MTB crew must be thoroughly familiar with and capable of operating all armament on board. Training toward higher standards of personnel operating efficiency should be continuous. Safety orders will be posted in conspicuous places near the ordnance equipment concerned. These safety orders must be rigidly observed at all times.

4202. Care and upkeep of weapons.-The gun armament on MTB's consists of rapid fire machine guns which require meticulous care and constant routine maintenance to keep them in proper condition for effective use. They are exposed to large quantities of salt spray and even under most favorable conditions will receive rough treatment. Every effort should be made to keep all guns in a high state of readiness. In this connection light canvas muzzle bags should be fitted on guns when it is necessary to keep them trained on bearings where salt water is likely to fill up the bores. In case of emergency the gun can be fired with muzzle bags on.

4203. Fire control.-Gun control in MTB's is primarily a matter of firing the maximum number of guns at enemy targets within machine gun range. The .50-caliber and 20-mm. machine guns are short range weapons with a very high rate of fire. Their fire must be held until the target comes within their

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range. Indiscriminate firing at distant targets must not be permitted. The ammunition for these guns is expended very rapidly, only a limited amount can be carried on board, it is precious and for use at the proper time. These guns are for defense against dive bombers, strafers, low position glide bombers, and for offense or defense against small surface craft, large surface craft (during close in or night attacks) and submarines on the surface.

4204. Fire distribution.-No standard fire distribution plans are necessary. During night torpedo attacks MTB's will seldom, if ever, be in formation. During daylight torpedo attacks it is doubtful if the attack can be pressed in to machine gun range. Against aircraft, the nearest and most menacing target should be engaged and concentrated on.

4205. Surface targets.-If surface craft are engaged by MTB's in formation, all enemy ships being attacked must be kept under fire. Whenever the number of torpedo boats exceeds the number of enemy ships, the fire will be distributed as evenly as possible. Crossfire should be avoided. Maneuvers should be made in a manner that will not mask the fire of any boat, but if, possible to mask some of the enemy's guns.

4206. Aircraft targets.-When engaging enemy aircraft, maneuvers should be made in a manner that will afford mutual fire support and avoiding enfilade. (See art. 3903.)

4207. Directing fire.-When engaging enemy surface craft, fire should be directed at the bridge, control stations, exposed gun crews and (if at night) searchlights. Against a submarine, it is possible with well directed machine gun fire to prevent the submarine from manning his guns, and either force him to surrender, or to submerge and lose the men on deck.

4208. Firing at night.-During night or low visibility an MTB should never open fire against a surface ship unless it is certain that the MTB has been sighted or that the surface ship itself is poorly armed. During daylight high visibility, it can be assumed that an MTB has been sighted by the time the enemy is within gun range.

4209. Orders for opening fire.-When in formation boats should follow the movements of the leader in opening fire. However, any boat observing aircraft actually attacking should fire a short burst in the direction of the attack if it is believed the other boats have not seen the plane or planes. Vessels observing enemy surface craft or distant aircraft which it is believed the leader has not seen, should pass the information

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by visual signal or radio. Orders to open and cease fire will always be given from the conning station and must be strictly obeyed.

4210. Opening fire ranges.-The maximum opening range for 20-mm. and .50-caliber machine guns should be 2,000 yards. This is the "tracer burn out" range for both weapons and is also the limit of their accuracy. When firing at aircraft, opening fire ranges considerably less than 2,000 yards should be used in order that fire will not have to cease due to an expended magazine in the case of the 20-mm. and an overheated gun in the case of the .50-caliber. Recommended ranges for opening fire are:

Dive bomber-1,500 to 2,000 yards.
Strafer, low position glide bomber or torpedo plane-1,000 to 1,500 yards.

NOTE.-MTB's can be used to a great advantage in protecting large vessels against surprise torpedo plane attacks by taking station at approximate points of torpedo release thus subjecting these planes to much additional gunfire.

4211. Firing on attacking aircraft.-If planes are attacking in rapid succession, fire should never be continued on planes which have passed overhead. It should always be directed at incoming planes. The principle of engaging the nearest and most dangerous targets applies.

4212. Lookouts.-The importance of keeping an extremely bright lookout in all directions cannot be overstressed. Each man having a battle station above deck should be assigned a search sector. Dive bombers invariably attack from the direction of the sun. The lookout assigned that sector should wear

dark glasses. MTB engines are as loud as those of an airplane. This factor may enable a plane to attack a boat that is "not alert" before any gun on the boat can be brought to bear.

4213. Standard terms.-Definitions of terms used in control of machine gun fire are as follows:

(a) "Track" is an order given before "commence firing" and means bring the guns into firing position and follow target.

(b) "Tracking" is a general term meaning the art of moving the gun smoothly and steadily keeping the sights or tracers constantly on the target.

(c) "Individual tracer control" is a method of fire in which the gunner plays the tracer stream on the target in same manner as he would water from a hose.

(d) "Tracer control" is a method of firing in which the gunner uses tracers at the target, to assist in tracking.

(e) "Sight control" is the method of firing in which the gunner uses sights in tracking the target.

(f) "Tracer cut back or tracer curve illusion" is the apparent curve in the path of tracers as they pass a moving target. This is due to the relative movement between target and tracer.

(g) "Superelervation" is the added angle of elevation necessitated by a projectile's trajectory. It is the angle between a line from gun muzzle to any given point in space and the axis of the gun when laid so that projectiles will hit the given point.

(h) "Slant range" is the range along the line of sight from gun muzzle to the target.

4214. Individual tracer control will normally be the method used in firing machine guns on MTB's. Using this method, the gunner must not sight along the gun barrel while firing because in so doing, he is unable to observe tracers correctly. He must assume a relaxed position behind the gun and focus his eyes on the target. With his eyes so focused, he is best able to distinguish where the tracers are going in relation to the target. When hitting, tracers appear to be going through target in a curved line (tracer cut back). **Do not attempt to follow tracers from gun. Concentrate on area around target.** The gunner must track smoothly, always moving gun in direction of target course, **never toward the rear of the target**. If he is ahead of the target, he should slow his rate of track until the target enters the tracer stream, then resume correct rate. When behind, make a bold correction to bring tracers ahead of target.

4215. Tracer control wherein the gunner aims with sights but the tracers are observed at the target to assist in tracking and hitting. This method will be used:

(a) With 20-mm. fire when the Mark 14 gunsight is installed.

(b) If the ratio of tracers becomes less than one in five, due to scarcity of tracer ammunition.

4216. Mark 14 gunsight.-The Mark 14 gunsight is a gyro lead-computing sight which greatly increases the accuracy of

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20-mm. fire directed at rapidly moving targets. The sight is mounted directly on the gun, and requires no stabilized reference position or connections to the gun trunnion or ship's deck. The equipment is of the optical reflex type in which the line of sight, as indicated by an illuminated recticle, is displaced from parallelism with the gun bore. The angular displacement, or lead angle, corrects for the motion of the target during the flight of the projectile and introduces the necessary superelevation. The gunner swings the gun so as to hold the illuminated reticle on the target and another member of the gun crew makes the required adjustments for range effects by means of a manual control. This is usually done by first setting an estimated range and then introducing spots as prove necessary from tracer observation.

If tracers become less than one in five, ring sights should be installed on guns and tracer control used. All personnel should know how to aim using ring sights. The attitude and speed of the target determines the aim-off necessary. The speed rings indicate the amount of lead to be given for the target speed component **across** the line of sight and **not** the lead for the actual target speed. The tracers should be observed at the target to aid in determining the correct aim-off. "Smooth tracking is essential to tracer control."

4217. Sight control becomes necessary if no tracers are available. The discussion of tracer control applies except that there are no tracers to observe passing the target.

4218. Conditions of readiness.-For the condition of readiness of the gun battery see paragraph ___.

4219. Routines-Instruction books.-Routine upkeep, maintenance and overhaul forms will be provided and rigidly adhered to. The following publications should be used as guides and references in connection with the gun battery:

MTB familiarization pamphlet.
Bureau of Ordnance Manual.
O.P. 813-20-mm. A.A. gun and mount.
T.M. 9-12-25 -50-cal. B. A. M.
T.M. 9-12-26 -50-cal. B. A. M.
O.P. 529 -.45-cal. Thompson submachine gun.
O.P. 68 -.45-cal. Colt automatic pistol.
O.P. 595 -.30-cal. Springfield rifle.
O.P. 596 -.30-cal. Springfield rifle.

CHAPTER 3. DEPTH CHARGE ORDERS, STANDARD PROCEDURES AND NOTES ON SUBMARINE

4301. Types of depth charges.-Depth charges carried aboard motor torpedo boats may be one of the following types:

Mark	Weight of charge	Depth settings
	Pounds	*Feet*
Mark 3	300	50-300
Mark 6	300	30-300
Mark 7	600	30-300

Ordinarily the 600-pound charges are not carried unless smaller charges are not available. The depth charge racks mounted on motor torpedo boats accommodate 300-pound charges only, and if 600-pound charges are carried, they must be lashed on deck.

4302. Mark 6 charges.-Mark 6 charges should be carried whenever available, since the 30-foot depth setting is suited to shallow waters where motor torpedo boats are likely to operate.

4303. Condition of readiness.-During peacetime, depth charges if carried on board, will have pistol and booster mechanisms removed and placed in designated stowage. During wartime depth charges will be kept either in the "normal" condition or the "ready" condition. (See Armament Conditions of Readiness.)

Large white marks extending from the depth setting graduations on the pistol and to the outer periphery of each charge should be painted with corresponding large white numbers denoting depth settings. This will facilitate setting depths at night.

4304. Depth settings.-Normally the four forward charges should be kept set on 50 feet and the after four on 100 feet-depth of water permitting. This provides the best settings for the most likely encounter with

enemy submarines, that of sighting his periscope close aboard or catching him on the surface at night. Under other conditions depth settings should be staggered among the charges on board. Charges should be dropped in rotation from each side working from forward aft. This will provide a pattern and tend to keep the boat on an even keel.

4305. Depth charge sinking times.-The sinking times of depth charges dropped from MTB's are approximately as follows:

Depth	300 or 600-pound charge
Feet	*Seconds*
30	6
50	8
100	14
150	20
200	26
250	32
300	38

For a minimum depth setting of 30 feet MTB's should be making maximum speed when dropping charges to prevent damage to own boat. For deeper settings speeds may be decreased but only with caution. To prevent countermining charges should be spaced horizontally by at least 50 feet.

4306. Personnel training.-Frequent drill of personnel in setting the depth settings on depth charges should be carried out. All hands must be fully capable of conducting an attack and launching charges as there will probably be times when emergency conditions will preclude everyone getting to their regular battle stations. The importance of celerity in making the attack cannot be overstressed, since the possible area in which the submarine may be, increases as the square of the elapsed time.

4307. Procedure in attacking a submerged submarine.-In a coordinated operation if several MTB's are present, care must be taken that vessels are well deployed in a line. The cardinal sin in a coordinated operation is for one boat to get behind another in making an attack, thus preventing the first boat from dropping his charges.

The first and basic essential is to reach the submarine's position and drop depth charges with all possible speed. Since the submarine will undoubtedly withdraw its periscope and submerge to considerable depth as soon as attack is started, the attacking vessel is faced with:

(a) Keeping track of the bearing of the point at which submarine was last seen.

(b) Determining distance to that point.

(c) Deciding what "lead" to make for movement of submarine between time of last sighting and time depth charges explode.

4308. Keeping track of bearing.-Keeping track of the bearing should not be difficult if a compass bearing is taken, or the point lined up with a fixed object ashore. Correction must be made for own ship's turning circle in turning to the attack; this depends on angle of turn, and range to submarine.

4309. Determining distance.-The most difficult problem is that of determining the distance to run before starting to drop depth charges. The common error is to think in terms of land topography and place undue confidence in one's ability to recognize, upon reaching it, the spot at which the submarine was last seen. But once the periscope has disappeared, it almost always develops that no distinguishing marks can be found on the surface of the ocean, and the attacker finds himself unable to determine when he has run the proper distance. Hence it is important to estimate the distance to the periscope before it disappears, and coincidentally start a stopwatch or note the clock time. Then the proper time of run can be determined from speed-time-distance tables. Admittedly, this method involves the probability of error in range estimation, and involves consideration of acceleration of own ship; but unless there is some continuing indication on the surface to show the point of submergence, it is the best method available. Drill is required to ensure that the estimation of range, and starting of stopwatch, will not be forgotten in the excitement caused by the contact. Practice in estimating ranges is important. When patrolling at a known speed, estimates can be checked by clocking the times required to pass driftwood, etc., sighted ahead.

4310. Lead angle for attack.-The amount of "lead" to allow for movement of the submarine depends on many variables, the principal ones being speed of attacking ship, submerged speed of submarine, and relative bearing of attacking vessel from submarine. The problem should be studied in detail on a mooring board; as a thumb rule, the following angles of lead are suggested. These have been worked out on the basis of a submarine speed of 8 knots (the maximum), and assuming a constant submarine course, which conditions do not always obtain.

Lead angle for attack

Speed of attack (knots)	Submarine speed, 8 knots (depth charges set for 100 feet) Relative bearing (angle on submarine bow) of own ship from submarine (average range 1,000 yards)			
	0	30	60	90
--	180	150	120	--
20	0	14	25	27
25	0	12	20	23
30	0	10	17	19
35	0	9	15	17
40	0	8	14	15

4311 (a). Importance of lead.-This is again emphasized and it is repeated that the submarine will usually have way on and the one place he will not be is the exact spot where he was last seen.

(**b) Attacks on submarines on bottom.**-A submarine when attacked in shallow water may lie on the bottom either because of damage sustained or in an effort to throw off pursuit. Under these circumstances an attack should be made using depth charges set to detonate on the bottom. The standard depth charge can be so set by the following method:

(1) Drill or puncture a small hole in the safety cap.

(2) Set the charge to a depth which is less than the depth of water.

(3) Replace safety cap and drop charge with it on. When the charge is dropped it will sink to the bottom before sufficient pressure has built up to actuate firing mechanism.

4312. Use of charges and dropping.-When proceeding to attack the words "stand by depth charges" should be given and if a howler is installed it should be sounded. Personnel should then stand by racks, remove toggle pins on first charges and wait for signal from conning officer to pull safety forks and, release the first ones, moving to the next charges after releasing the first ones.

Once a good opportunity presents itself to attack, depth charges should be used liberally, as succeeding contacts if any, are not likely to be as good. In this connection if only one

motor torpedo boat is available to take part in the attack it will be good practice to save one or two charges in case the submarine is forced to the surface momentarily. It will also, be standard practice to remain in the area until other antisubmarine vessels arrive. If vessels with sound apparatus are in the vicinity they should be summoned immediately.

4313. After depth charging.-After an attack is made an alert and vigilant lookout should be kept for the submarine coming to the surface or being momentarily blown to the surface by the charges. Sometimes depth charges may so disturb the water as to cause the submarine to break surface. In the latter event it should be closed as rapidly as possible and torpedoed or further depth charged but above all it must be prevented from manning its guns. Thus the entire armament of the motor torpedo boat must be in instant readiness and guns trained on the bearing of the submarine.

4314. Aircraft assistance.-Aircraft can be of great assistance in locating submarines on the surface, or if not submerged at too great a depth (under good conditions, they have been located at depths up to 100 feet). Therefore surface craft should know the procedure used by aircraft to indicate the presence of a submarine. The standard procedure is for the plane to make repeated dives over the submarine and to drop a smoke float as close as possible. This float emits white smoke, and a small flame. The surface vessel should close the position indicated, keep the submarine submerged, and watch for further guidance from the aircraft. If the aircraft indicates a position of the submarine which can be reached by the surface vessel in less than a minute, one or more depth charges set for the 50-foot depth should be dropped at the position indicated by the aircraft. While the chance of actually destroying the submarine is small, its crew will be harassed.

4315. Upkeep.-Depth charge pistols and boosters should be frequently removed from the cases and inspected. Instructions for the testing maintenance and overhaul of pistol and booster mechanisms may be found in O.P. 555. Descriptions and features of operation will be found in O.P. 747. Depth charge racks should be frequently examined for fractured members and maintained in proper operating condition. Standard routine upkeep sheets should be followed and rigidly adhered to.

4316. Notes on submarine characteristics.-(a) The full speed of a submarine on the surface varies according to her design and may be anything from 10 to 22 knots. A large modern

submarine may have a cruising range of 10,000 miles and more, and hence be able to conduct extensive operations without refueling.

(b) The full speed of a submarine submerged may be taken as 10 knots, but due to the limited capacity of the storage battery, this can only be maintained for about 1 hour. If, however, the submerged speed is kept down to the minimum, say 3 knots, this can be maintained for 24-30 hours.

(c) This limitation of submerged endurance is a most important point to bear in mind. When the battery is exhausted, the submarine must either come to the surface to recharge, or rest on the bottom (if the depth is not too great). Even so, she cannot remain on the bottom indefinitely and must eventually come to the surface to recharge. Therefore, a submarine when submerged will much prefer to work at a low speed in order to conserve the battery. Any harassing action which forces the submarine to use high speed while submerged, and prevent it from rising to charge batteries, is thus very valuable, even though no immediate results may be apparent.

(d) Contrary to popular opinion, a submerged submarine can remain in a static condition, without headway. This requires, however, a rather delicate balance, and the submarine will generally prefer to rest on the bottom, provided the depth of water is not over 50 fathoms and the character of the bottom is suitable.

(e) A submarine on the surface may be assumed to be always ready for diving. By so-called "crash diving" a submarine can submerge to periscope depth (50-65 feet) in about 30 seconds, to 100 feet in about 70 seconds and to 200 feet in about 110 seconds. Rough weather will probably increase the above times slightly. Generally speaking the smaller the submarine the quicker it can submerge.

(f) The following action is to be expected when a submarine crash dives:

(1) Escaping air from main tank vents all along the upper deck will make a loud noise and cause spray. Later, as the upper deck submerges, bubbles will appear.

(2) The submarine will go full speed until under water, turning beam-on to the sea.

(3) In order to reduce the danger of a break-surface the submarine will go to a depth of at least 80 feet and probably to 200 feet or more.

(4) The water where the submarine dived will form a slick, similar to a ship's wake. A swirl will be left where the bridge goes under.

(5) Periscopes are always housed and invisible when on the surface, but one will probably be put up as the submarine dives in order to take a last view of the situation.

(g) Enemy submarines probably are able to withstand pressures equivalent to 500-600 feet. However, they will seldom dive by choice to greater than about 350 feet, and will stay at periscope depth whenever possible, the better to survey the situation.

(h) All submarines, except the smaller type, usually carry one or two guns of 3- to 6-inch caliber. They are also equipped with machine guns. In fact, submarines will very possibly have a much more powerful gun battery than the small patrol vessels which hunt them; but the submarine is at a distinct disadvantage in that being thousands of miles from her base, the slighted damage which she sustains may prove fatal.

(i) Most submarines have two periscopes, but use only one at a time. The diameter of the exposed part is between 11/2 and 5 inches, and the periscope can be raised or lowered at will, while the submarine maintains a constant depth. With periscope fully extended, the distance from top of periscope to deck is about 33 feet (to keel, 55 feet). It is common practice to expose the periscope only intermittently, extending the top from 1 to 4 feet above the surface for a period of 5 to 10 seconds.

(j) The periscope leaves a "feather" (wake) which varies with the speed, and which often is easier to see than the periscope itself.

(k) Submarines frequently lie on the surface in the awash condition, with only the conning tower above water. This permits use of the Diesels, while at the same time facilitating quick submergence, and reducing chances of detection.

(l) Enemy submarines have used this "surface awash" condition in a large percentage of their night attacks, especially in night attacks against convoys. They approach in the awash condition, running on Diesels, then fire their torpedoes and either submerge or retire at high speed on the surface.

(m) The firing position most desired by a submarine is from 45° to 60° or the bow of the target, at a range inside of 2,000 yards. Thus the first aim of an escorting vessel is to deny this favorable position to the submarine. A vessel without

sound equipment can best do this by occupying that position himself, or being in position where he can keep close watch on the area. Additional vessels can profitably be stationed farther aft, or on the bows of other ships of the convoy.

(n) If, however, the escorting vessel maintains a fixed station, the submarine is enabled to avoid him and fire from another, if slightly less favorable position nearby. Therefore, escorting vessels should continuously vary their positions, using their assigned station merely as the center of a general area to be covered. This is referred to as "patrolling the station."

CHAPTER 4. SMOKE SCREEN ORDERS AND STANDARD PROCEDURES

4401. Smoke screen generators.-The purpose of the smoke screen generator is to provide means of laying smoke from motor torpedo boats using F. chemical mixture or other suitable compound. The importance of smoke aboard motor torpedo boats and its proper use cannot be aver emphasized. It provides a means of approaching to within effective torpedo ranges of the enemy during daylight and offers an excellent means of defense and escape from superior enemy surface or air forces.

4402. Maintenance and upkeep.-Smoke laying apparatus should be kept in a high state of repair and in good operating condition. In view of the fact that it may be required for offensive or defensive measures on any mission which motor torpedo boats may be employed in, it should always be ready for instant use.

4403. Personnel training.-All motor torpedo boat personnel should be fully trained in the operation of the smoke screen generator and the important function that it serves. The proper operation of this apparatus and the rapidity with which it is brought into use may at some time save the crew and boat from certain destruction.

4404. Smoke screen notes.-(a) The location of screen when laid is determined by the apparent wind which in turn is dependent on the actual or true wind and the course and speed of the boat. The direction of apparent wind is easily determined by the direction in which pennants and exhaust smoke stream. Once laid the screen will move bodily in direction of true wind.

(b) F. S. mixture generates smoke when mixed with the **moisture in the air**. Humidity therefore effects the density of the screen.

(c) Smoke is heated by reaction with moisture and so will tend to rise. It cools and stops rising at 200- to 300-feet altitude.

(d) A screen does not need to be entirely opaque to be effective. Its purpose is to hamper gunfire and render sighting and spotting difficult or impossible. Smoke has been tried successfully by PT boats to assist in escaping the enemy after detection and to provide a screen through which friendly boats may launch an attack.

(e) Under some conditions it may possibly be necessary for more than one boat at a time to collaborate in laying a screen to obtain sufficient density. In such a case it is important that second boat lay smoke to coincide with screen of first vessel.

(f) One tank of F. S. smoke is estimated to be capable of laying a screen of practicable density for about three miles at maximum speed.

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PART 5. ENGINEERING AND COMMUNICATIONS DOCTRINE

CONTENTS

CHAPTER 1. ENGINEERING PRACTICES

5101. Safety precautions.-Rigid adherence to safety orders is an absolute necessity in motor torpedo boat machinery operation and any laxness in this regard cannot be tolerated. The amount and high volatility of the fuel carried and the relative large quantity of explosives concentrated on board, makes the motor torpedo boat extremely hazardous with regard to fire and explosion. The high operating speeds and unstability of the hull give rise to dangers to personnel working in machinery spaces. Careful and diligent compliance with all safety rules will minimize the hazards and prevent casualties.

5102. Conservation of machinery.-Every effort must be exerted to conserve machinery on board in order to have a reserve of power for emergencies. All machinery in a motor torpedo boat has been made as light as possible for efficient operation and the hours of use available on each unit are relatively short before an overhaul is necessary. Most overhauls and repairs cannot be made while underway and therefore the boat must remain inactive while machinery is removed, replaced, or repaired. In this connection, a common violation is the excessive use of clutches and engines in making a landing alongside a dock. A good landing is one that causes a minimum of damage to the boat. To jockey back and forth in order to make a four-point landing, at the expense of the engines and a dozen shifts on the reverse gears, is.definitely a damaging operation. MTB's are very light and can readily be hauled in by hand once the dock is approached closely enough to get a line or two across. Another violation is running the engines unnecessarily at excessive speeds, which tends to shorten their life.

5103. Auxiliary generators, batteries and wiring.-These units may properly be considered the "life blood" of the boat. They

supply the energy for lighting, operating the radio, firing torpedoes and heating food. The importance of their conservation and proper care, in order to be available for emergencies, is obvious. Hence never shorten the life of the auxiliary generator by running it when other sources of power are available. If in port, batteries should be removed from the boat and charged from tender or shore facilities rather than by charging from auxiliary generators. Tender or shore current should be used whenever possible, for lighting or heating food. Careful inspections and tests of all electric wiring should be made at frequent and periodic intervals.

5104. Machinery inspections and operation.-The machinery installed in MTB's is extremely delicate, of precision construction, and must be operated accordingly. Instructions in machinery operating manuals and instruction books will be followed. It has been necessary to sacrifice certain factors of ruggedness in order to conserve in weight. Frequent and periodic routine inspections must be rigidly carried out on all machinery, in accordance with existing instruction and operating manuals, to discover any deficiencies that subsequent operation will aggravate into major or minor casualties. Care and upkeep that would prove adequate for the satisfactory operation of a heavy duty, slow-moving marine engine is far from adequate on a MTB. Personnel must pay careful attention to temperatures, oil pressures, etc., in order to prevent damage to machinery.

5105. Repairs.-It will often be necessary to effect repairs of an emergency nature that fall in the "baling wire" category. However, these repairs should be replaced with permanent ones at the first opportunity, in order to restore the original installation. All repairs should be effected in an approved manner and in accordance with existing machinery instruction books.

5106. Spares.-The amount and types of spares to be carried on board should be limited to those needed for repairs which can be made while under way. This will reduce the weight of the boat and keep the spares in better condition.

5107. Safety orders and machinery operating instructions.-These will be posted in conspicuous places near the machinery units to which they apply, and frequently read to the crews.

5108. Cleanliness.-Cleanliness of engineering spaces and machinery is a requisite of good engineering practice and in motor torpedo boats must be strictly enforced. Clean machinery and machinery spaces reduce the danger of fire and minimizes the

possibility of foreign material reaching the vital parts of the machinery.

CHAPTER 2. COMMUNICATIONS

Doctrine and Practice

5201. Communications in motor torpedo boats are difficult even under good conditions due to the unstable platform, exposure of personnel to seas and weather, and the limitations of the facilities available on board.

5202. Facilities.-The following facilities are available for communications:

(1) Radio telephone and telegraph with limited output range and power supply.
(2) Signal flags.
(3) Semaphore flags.
(4) M. P. (multi-purpose) signal light.
(5) Blinker tube.
(6) Searchlight.
(7) Arm signals.
(8) Verys pistols.
(9) Code and cipher publications similar to those carried by aircraft.
(10) Radio direction finder.

5203. Radio transmissions.-In view of the necessity for radio silence during wartime or the transmissions of radio messages in code, use of the radio will normally be restricted on motor torpedo boats and confined to very urgent messages. However, during the progress of a motor torpedo boat attack on the enemy, or if being attacked by the enemy, full use of the radio should be made, if it will add to the effectiveness of the attack or counterattack.

5204. Visual communications.-Visual communications should be used whenever possible. During daytime operations when motor torpedo boats are in small compact formations, hand and flag signals will normally be the primary method of communicating between boats. At night, when the security of position will not be disclosed, blinker tube or signal light will be necessary. If light signals cannot safely be used, boats will close and communicate by word of mouth.

5205. Encoded messages.-When encoded radio communications are permitted and the necessity for communications between boats is urgent, it will be found expeditious to arrange certain

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code words in advance to denote phrases appropriate to the particular mission on which to be engaged. This will preclude use and probable compromise of, official code publications which ordinarily cannot be conveniently carried or used aboard motor torpedo boats. For communicating with other units of the fleet, the aircraft signal book and contact report pads are adequate and should be carried on board.

5206. Authenticators.-Radio personnel should develop the habit of recognizing the voices of their contemporaries on other boats, thus eventually eliminating the need for authenticators when orders are transmitted by radio from one boat to other boats.

5207. Conservation of power.-(a) The necessity for conserving power when operating in motor torpedo boats and the importance of keeping radio equipment in an excellent state of repair cannot be too greatly emphasized. Emergencies may occur requiring continuous operation of the radio for long periods. Also circumstances may arise where the state of readiness of the radio may determine the destruction of one's own forces, an enemy force or the destruction of an individual boat and crew.

(b) Maintenance and periodic overhaul of material should be made in accordance with the prescribed check off lists and weekly reports. **(c)** Effective safety measures should be continually employed to prevent the following:

(1) Shorting of wires and sparking of loose connections.

(2) Injury to personnel from dangerous voltages in antenna and transmitter.

(3) Creation of explosive hydrogen gases in storage batteries due to improper ventilation.

(4) Static electricity and consequent sparking as a result of broken bonding.

(d) Radio direction finder equipment should be calibrated as soon as the boats are received and calibration curves should be kept posted in the immediate vicinity of the equipment.

5208. Standard procedure.-(a) Standard procedure is absolutely essential and must be adhered to by personnel operating the radio. Some of the more important details of proper procedure are given below. A complete guide is given in Naval Communication Instructions.

(b) In wartime encoded call signs are assigned to and used by each boat to preserve secrecy of identity. The examples below

give the regular calls for simplicity: Assume the PT 1 wishes to call the PT 2 and order it to return to base.

Step 1-2 from 1, 2 from 1, *answer*.
Step 2-1 from 2, *go ahead*.
Step 3-2 from 1, return to base, *acknowledged*.
Step 4-1 from 2, *wilco*.

(c) The above steps illustrate the following basic principles:

Step 1-The addressee's call is always given first. Answer is used when trying to establish contact with another boat.

Step 2-Go ahead is used when contact is established and when either the addressee or the sender is ready for the other party to "come back".

Step 3-Acknowledge is standard phraseology for requesting *acknowledgment*.

Step 4-Wilco means "I will comply" and is used by a boat on receiving instructions from a senior boat to carry out an order. The use of *wilco* should not be confused with that of the word *roger*. *Roger* is used merely to acknowledge that a message is received; it does not imply the intention to comply.

5209. Operation.-Efficient radio communication requires constant effort to eliminate the following practices:

(a) The use of unauthorized procedure which permits the enemy to associate types of craft with the operating peculiarities of the personnel.

(b) Unnecessary use of the radio. This is the most common form of bad communication practice. It is dangerous in that it permits radio direction finding and consequent compromise of security of position.

(c) Excessive test counts. Test counts should be held to an absolute minimum.

(d) Operation of the radio by inadequately indoctrinated personnel.

5210. Personnel.-All members of a MTB crew must be qualified in standing a radio watch. Each man

must have an operating understanding of the radio equipment, know the Morse Code, understand the effective call sign, and Recognition and Emergency Identification System. Each man must know MTB communications procedure as well as the basic principles of sound communication practice set forth in Communications Instructions. The importance of training and disciplining operating

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personnel in the developing of sound communication habits cannot be overemphasized. In the last analysis the standard of radio communication efficiency will largely depend on the intelligence of the personnel and therefore selection of only the best qualified is of paramount importance.

5211. Recognition and identification.-(a) Because of the similarity of the general appearance between MTB's and submarines, MTB's are not infrequently mistaken for enemy submarines by friendly surface vessels and aircraft. It is, therefore, of the utmost importance that MTB personnel be trained to use maximum speed in identifying themselves. Emergency recognition signals and Verys pistols should always be kept at hand to avoid a moment's delay when needed.

(b) The communication officer on MTB's should have made out daily, the following lists for all MTB's in the squadron:

Four days recognition and emergency identification signals.
Encoded calls.

No boat captain should get underway without having these lists aboard and he should be personally responsible for turning the list in when his boat returns to base.

5212. Confidential publications.-Confidential publications carried on board MTB's should be carried in a locked W. T. case which will readily sink when thrown overboard, in case the boat is captured or destroyed. These cases should be turned in to commanding officer upon return to base.

5213. Security.-The highly confidential nature of certain military characteristics of motor torpedo boats must be guarded against compromise. New personnel, personnel under training and civilian contractors working in an official capacity with motor torpedo boats must be thoroughly instructed regarding the importance of preserving the inviolability of confidential information regarding the size, seaworthiness, cruising radius, speed, armament, armor and operations of motor torpedo boats.

  

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PART 6. USEFUL INFORMATION AND DATA

CONTENTS

CHAPTER 1. (A) ARMAMENT-CONDITIONS OF READINESS

6101. General.-During wartime there will be two conditions of readiness of the armament: **Ready condition** and **fully ready condition**. The armament may be in the ready condition when boats are under repair, secured, moored to a dock or on training runs when action with the enemy is not probable. On any occasion where action with the enemy is probable, the armament will be in the fully ready condition and partially or fully manned, depending on the circumstances and on the mission on which engaged. In placing the armament in the fully ready condition extreme care must be exercised inside the harbors or other areas where own or friendly vessels may be endangered by accidental discharge of weapons.

6102. Battle stations.

GENERAL QUARTER-CONDITION 1

Boat captain-Conn: Wheel or throttle.
Executive officer-Throttle or wheel.
GM-Oerlikon gun.
Tm-Stand by torpedoes or depth charges.
QM-Ammunition passer for .50-caliber guns.
RM-Radio.
MM-Engine room. MM-Starboard .50-caliber guns.
MM-Port .50-caliber guns.
Sea-Loader for Oerlikon-gun.

NOTE.-The above may and should be changed to utilize special aptitude or training of any man.

CONDITION 2

Station	Watch 1	Watch 2
Conn	Captain	Executive Officer.
Communications and navigation	RM	QM.
Wheel, torpedoes	TM	GM.
.50-caliber guns	SC	MM.
.50-caliber guns	Sea	
Engine room	M M	M M.

6103. Torpedoes-Ready condition.

1. Preliminary and final adjustments.
2. Charged to between 2,000-2,800 lb. per sq. in.
3. Warhead attached, exploder and booster in.
4. Two brass stop pins in place.
5. Tubes trained in, not secured.
6. Firing keys in commanding officer's key locker.
7. Impulse charges in provided stowage.
8. Director mounted and cover on.
9. Canvas muzzle bags on tubes.

6104. Torpedoes-Fully ready condition.

1. Tubes trained out and secured in that position.
2. Current on firing circuit.
3. Impulse charges loaded, firing pin on "safe".
4. Firing keys inserted.

WHEN ACTION IS IMMINENT

1. Shift firing pin to firing position.
2. Men standing by tubes with mallets for percussion fire.

6105. .20-mm. gun-Ready condition.

1. Gun oiled and ready to fire mechanically, uncocked.
2. Gun cover on and not secured except in wet weather.
3. Magazine filled and in ready boxes. Extra magazines filled and on board.

6106. .20-mm. gun-Fully ready condition.

1. Gun cocked; should be uncocked for a few minutes every four hours when weather permits.
2. If weather is wet, cover over magazine and breech mechanism, not over muzzle.

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3. Safety on until ready to commence firing.
4. Magazine in place.
5. If weather permits gun manned continuously. If not gun secured pointing up.

6107. .50-caliber gun-Ready condition.

1. Guns clean and well oiled.
2. Oil buffers filled.
3. Head space set.
4. One thousand rounds up in each turret well cleaned and free from corrosion; not led up to gun.
5. Spare magazines loaded and at hand in tank room.
6. Waterproof cover on and secured only in wet weather. Normally off during daylight. Covers on, not secured at night.

6108. .50-caliber gun-Fully ready condition.

1. Lead belt up to gun, half load, put on safety.
2. If weather is wet, keep muzzle bags on guns, cover over turret.
3. Guns manned, trained on bow or probable target bearing.

6109. .45-caliber submachine gun-Ready condition.

1. Gun well oiled, cleaned and adjusted for firing.
2. Gun secured to port inside bulkhead of lower control station.
3. All magazines loaded and secured close to guns.
4. Magazines never to be installed until ready to open fire.

6110. .45-caliber submachine gun-Fully ready condition.

1. Removed from stowage and in hands of gunner.
2. Magazine at hand, ready to be loaded.
3. Gun cocked; safety on.

6111. Depth charges-Ready condition.

1. Pistols, extenders, detonators, and boosters installed.
2. Knobbed safety forks in place, not wired to rack.
3. Plain safety caps on.
4. Depth setting "safe".
5. White lines painted at 50 feet, 100 feet, 200 feet, 300 feet setting.
6. Depth charge howler operative.
7. Safety fork and toggle pin tripping gear in place.

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8. Knobbed safety cap with lanyard attached will be kept on each boat, ready for installation.

6112. Depth charges-Fully ready condition.

1. Replace plain safety caps with knobbed safety caps secured to racks. Do not wire safety forks to racks.
2. Depth settings are set as directed by boat captain after clearing port.

6113. F. S. generator-Ready condition.

1. Generator filled.
2. CO2 bottle charged.
3. Toggle pin in place on releasing handle, safety fork on toggle pin.
4. Releasing arm lashed with fish line to smoke tank ring.

6114. F. S. generator-Fully ready condition.

1. Same as "Ready".

CHAPTER 1. (B)

6115. .20-mm. gun data.

1. Rate of fire (not adjustable)-450 rounds/minute.

Muzzle velocity-2,725 feet/second.

2. Maximum depression, 5°. Maximum elevation, 87°.

3. Maximum range 5,500 yards at 36° elevation.

4. Time of flight:

500 yards 0.66 seconds.
1,000 yards 1.71 seconds.
1,300 yards 2.52 seconds.
1,500 yards 3.16 seconds.

5. At 35, 19-foot elevation (near maximum range).

Range 4,734 yards.
Maximum ordinate 3,840 feet 3,020 yards from gun.
Time of flight 31.74 seconds.

6. 50 percent zones.

Range	Length	Breadth	Height	Drift
Yards	*Yards*	*Yard*	*Feet*	*Yards*
500	30	1	1	1
1,000	30	1	1	2
1,500	30	1	1	4

7. Superelevation.

Range	Angle of superelevation Angle of elevation of line of sight			
	0	30	45	60
Yards				
500	0°13'	0°11'	0° 9'	0° 6'
1,000	0°42'	0°36'	0°30'	0°21'
1,500	1°31'	1°19'	1° 4'	0°46'

It should be noted from the above that the Oerlikon characteristic makes for greater accuracy at high angles of fire.

8. *Life of barrel*.-The amount of life that a barrel will give, depends on how hot the barrel becomes during firing.

Five magazines, containing 60 rounds each, or a total of 300 rounds can be fired continuously without harm to the barrel.

Nine magazines, of 60 rounds each, or a total of 540 rounds, will cause serious wear if fired continuously.

If short pauses occur between the firing of each magazine, the wear will remain small, even after several thousand rounds.

During any prolonged firing, the barrel should be kept as cool as possible, either by frequent changes with the spare barrel, or by dousing the barrel with water.

6116. .50-caliber B. A. gun data (air cooled).

1. Rate of fire-500-650 rounds/minute-adjustable.
Muzzle velocity-(78 feet from muzzle).

Cartridges caliber-.50 M1-2,669 f/s.
Cartridges caliber-.50 M1,823-2,500 f/s.

Tracer is loaded to group with ball and A. P. at 1,000 yards.

2. Maximum range 7,125 yards at 642.3 mils elevation. Time of flight 39.7 seconds. Drift 6.7 mils.

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3. Time of flight.

500 yards 072 seconds.
1,000 yards 1.45 seconds.
1,500 yards 2.40 seconds.

4. Number of rounds first burst and subsequent bursts. An initial burst of 75 rounds may be fired, after which 20 rounds a minute may be fired. After waiting 15 minutes without firing, another 75 round burst may be fired. If an initial burst of only 25 rounds is fired, 25 rounds a minute may be fired continuously. The above rate of fire prevents overheating the gun, impairing its accuracy, and reducing its life. However, in combat the gun may and should be fired without regard to this.

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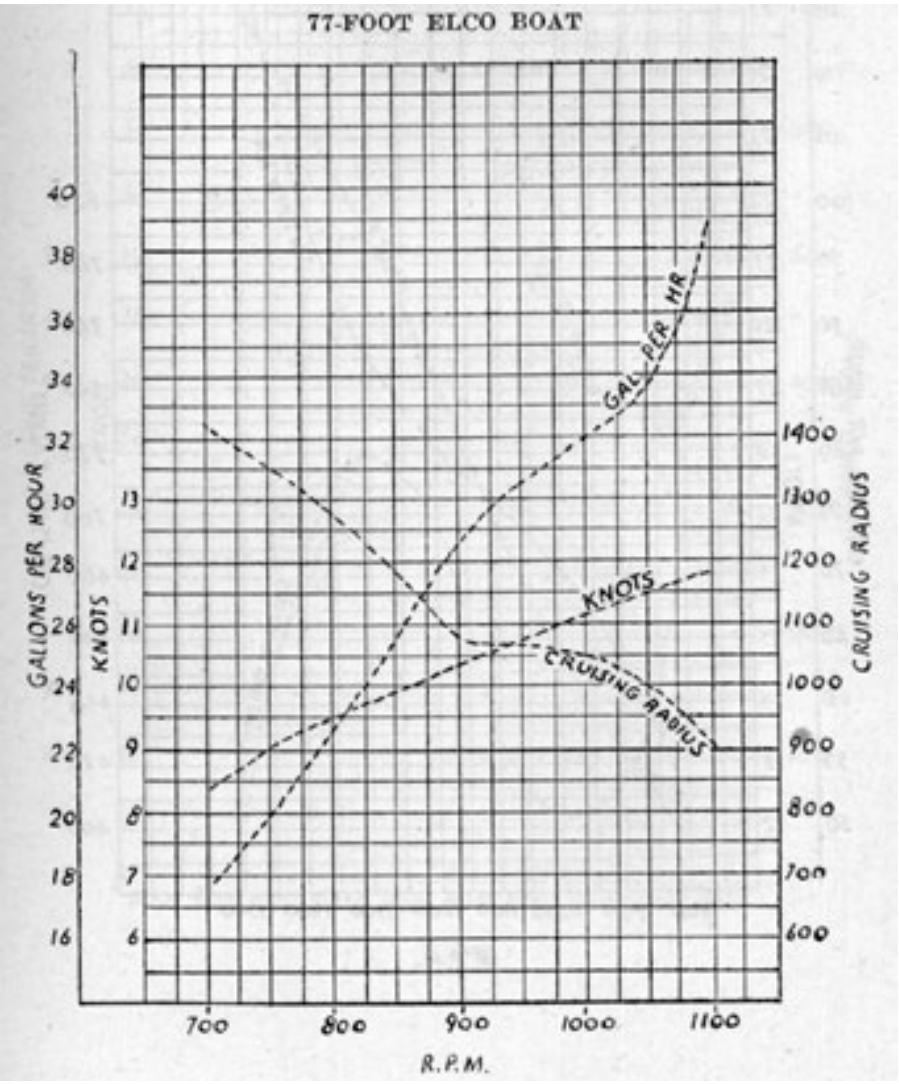
CHAPTER 2. MISCELLANEOUS DATA

A. Fuel Consumption and Cruising Radius

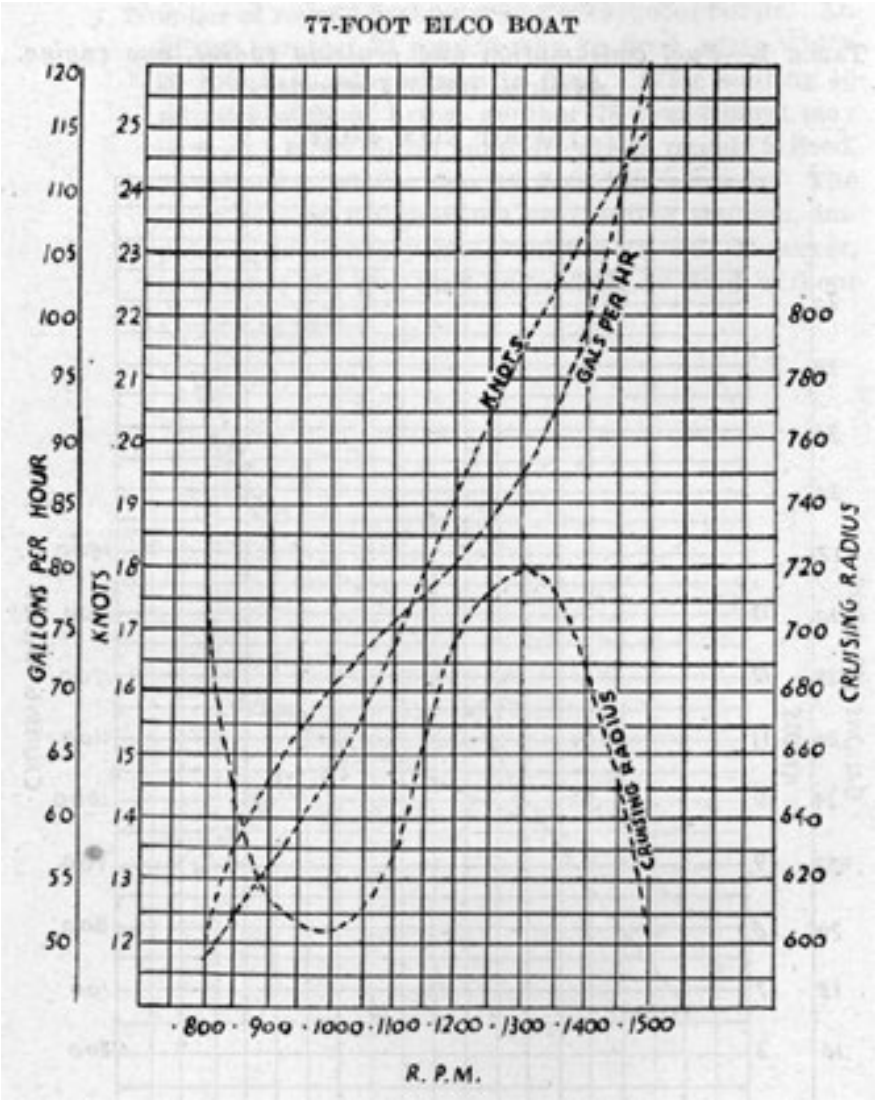
6201: One engine operation.

TABLE 1.-*Fuel consumption and cruising radius, one engine, Admiral, (29/30) wheels*

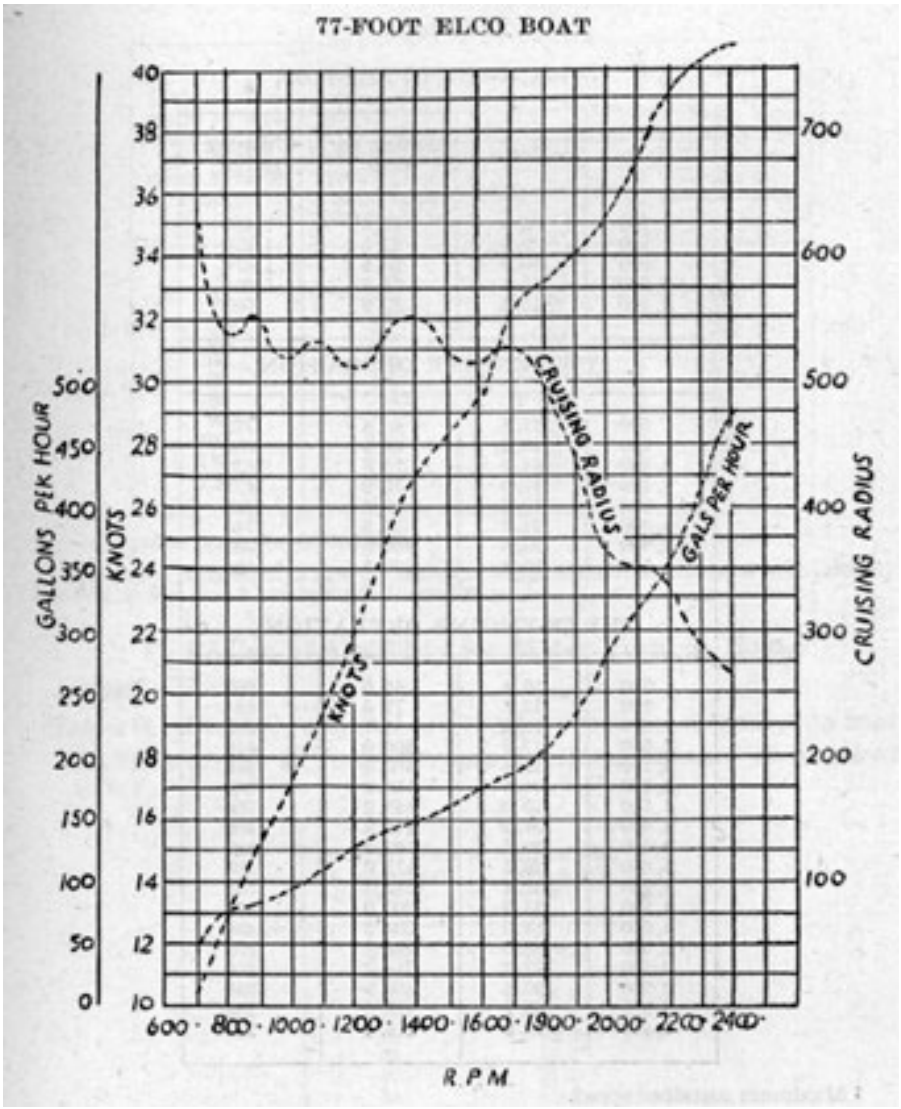


6202. Two engine operation.

TABLE 2.-*Fuel consumption and cruising radius, two engines, Admiral, (29/30) wheels*



6203. Three engine operation. TABLE 3.-*Fuel consumption and cruising radius, three engines, Admiral, (29/30) wheels*



6204. Composite table of all combinations.

TABLE 4.-*Gasoline consumption with Admiral (29-30) wheels -77'*

Elco boat

ONE-ENGINE OPERATION

R. p. m.	Knots	Gallons per hour	Cruising radius
700	8.3	17.5	1,420
800	9.5	22.5	1,270
900	10.3	28.8	1,070

[1] 1,000	11.1	31.7	1,050
1,100	11.8	39.2	903
TWO-ENGINE OPERATION			
800	11.8	45.8	772
900	13.2	62. 5	633
1, 000	14. 7	70. 8	623
1, 100	17. 0	75. 8	672
[1] 1, 200	19. 3	80.8	718
1, 300	21. 5	87. 5	740
1, 400	23.5	100.8	704
1, 500	25. 1	120. 8	625
THREE-ENGINE OPERATION			
700	10.4	46.6	669
800	12.8	72.5	531
900	15.2	81.7	558
1, 000	17.2	100.0	516
1, 100	19.4	107.5	542
1, 200	21.8	129.2	506
1, 300	25.0	140.0	536
1, 400	27.2	145.8	560
1, 500	28.4	162.5	524
1, 600	29.5	175.0	506
1, 700	32.4	183.3	530
1, 800	33.2	200.0	498
1, 900	34. 0	234.2	436
[1] 2,000	34.9	292.5	358
2, 100	37.2	314.2	355
2, 200	39.4	350.9	336
2, 300	40.2	426 6	282
2, 400	40.9	474.2	259

[1] Maximum sustained speed.

Sea-Moderate.
Displacement 94,500.
Draft aft-5 feet 3 inches.

Draft forward-2 feet 5 inches.

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B. Submarine Data

6205. Rate of descent and lateral speed in crash dive.

TABLE 5.-R*ate of descent and lateral speed in crash dive*

Time (in seconds) submarine sighted and starts crash dive at 0 second	Lateral distance (yards) traveled by submarine-measured from point where submarine started dive	Depth setting (feet)	Lead (yards) to obtain hit-measured from point where submarine started dive
0	0	50	30
[1] 30	105	50	135
40	140	100	185
50	175	100	220
60	210	150	271
70	245	150	306
80	280	200	357
90	315	200	392
100	350	250	443
110	385	250	478
120	420	250	513

[1] Submarine periscope submerges.

The above is based on a rate of sinking of 300-pound depth charge of 6 foot/seconds for first 50 feet and 9 foot/seconds thereafter.

C. Radius of Visibility for Motor Torpedo Boats

6206.

TABLE 6.-*Distance a vessel can be seen from a motor torpedo boat (height of eye 12 feet-horizon 4 miles-distance in nautical miles)*

A vessel with a masthead height of-	Can be seen from a PT at-
Feet	*Miles*
100	15. 5
80	14. 3
75	13.9
70	13. 6
65	13. 2
60	12.9
55	12.5
50	12. 1
45	11. 7
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HMAS *Diamantina*, South Brisbane, Queensland
SS *Forceful*, South Brisbane, Queensland
HMAS *Advance*, Sydney, New South Wales
Commando Boat *Krait*, Sydney, New South Wales
MB172 Epiclass, Sydney, New South Wales
HMAS *Onslow*, Sydney, New South Wales
HMAS *Vampire*, Sydney, New South Wales

HMAS *Whyalla*, Whyalla, South Australia

CANADA

RV *Ben Franklin*, Vancouver, British Columbia
RCMPV *St. Roch*, Vancouver, British Columbia
HMCS *Fraser*, Bridgewater, Nova Scotia
HMCS *Sackville*, Halifax, Nova Scotia
HMCS *Haida*, Hamilton, Ontario

ENGLAND

HMS *Belfast*, London
HMS *Cavalier*, Chatham

FRANCE

FS *Colbert*, Bordeaux

GREECE

B/S *Georgios Averoff*, Athens

ISRAEL

INS *Af Al Pi Chen*, Haifa
INS *Mivtach*, Haifa

NETHERLANDS

HNLMS *Tonijn*, Den Helder
HNLMS *Abraham Crijnssen*, Den Helder
HNLMS *Schorpioen*, Den Helder
Hr. Ms. *Buffel*, Rotterdam
Hr. Ms. *Mercuur*, Scheveningen

NORWAY

M314 *Alta*, Oslo

PERU

BAP *Abtao*, Callao

RUSSIA

Cruiser *Aurora*, St. Petersburg
Soviet *B-413*, Kaliningrad
Icebreaker *Krasin*, St. Petersburg

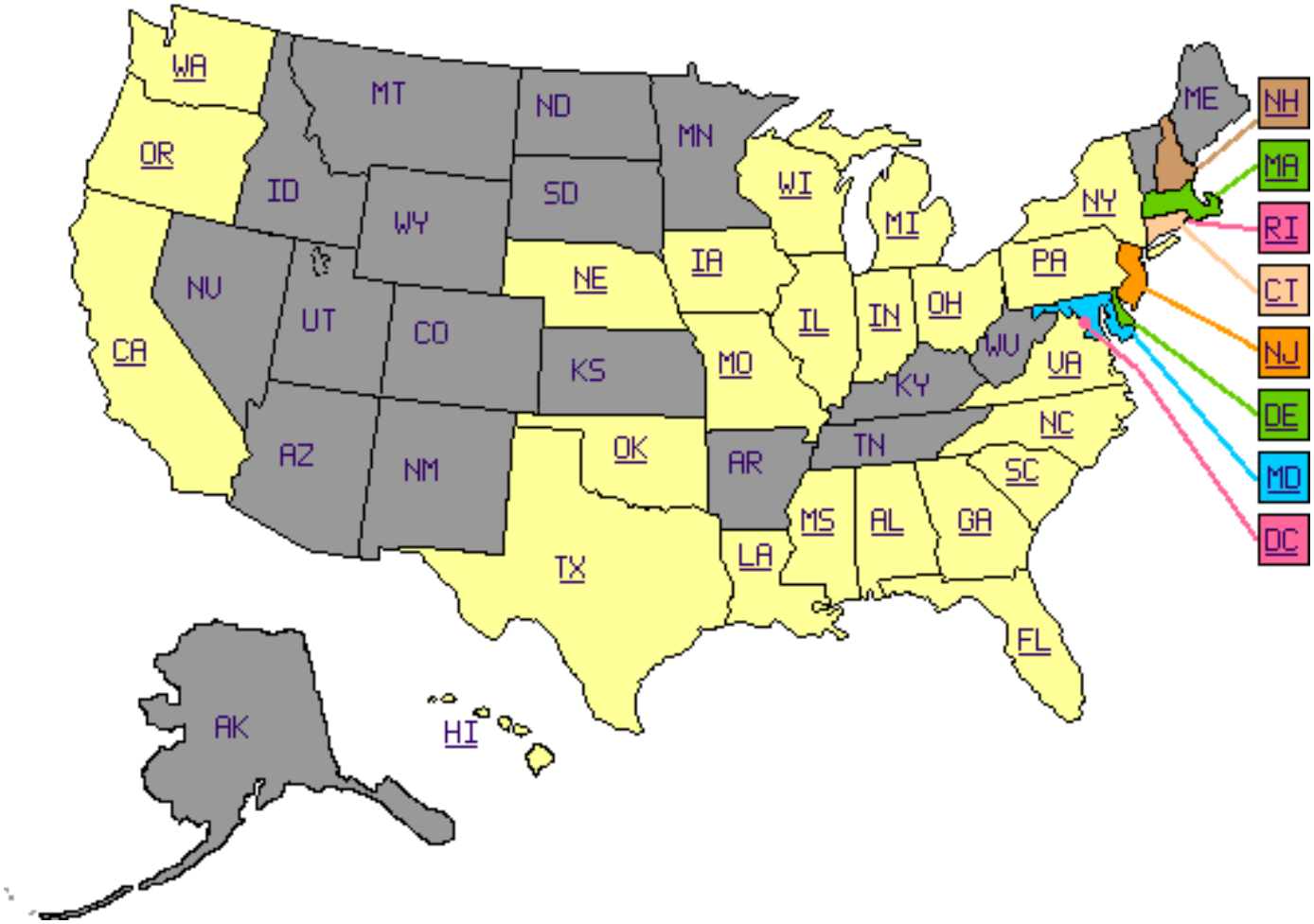
SWEDEN

T121 *Spica*, Stockholm

TURKEY

TCG *Uluçalireis*, Istanbul

UNITED STATES OF AMERICA



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Alabama

USS *Alabama*, Mobile, Alabama
USS *Drum*, Mobile, Alabama
PBR Mark II, Mobile, Alabama

Arkansas

USS *Razorback*, North Little Rock, Arkansas

California

USS *Hornet*, Alameda, California

USS *Potomac*, Oakland, California
Lightship *Relief*, Oakland, California
SS *Red Oak Victory*, Richmond, California
USCGC Fir, Rio Vista, California
PTF 26, Rio Vista, California
USAT *LT-1967*, San Diego, California
Steam Yacht *Medea*, San Diego, California
USS *Midway*, San Diego, California
SS *Jeremiah O'Brien*, San Francisco, California
USS *Pampanito*, San Francisco, California
SS *Lane Victory*, San Pedro, California
PBR Mark II, Vallejo, California

Connecticut

USCG Boat *Icebucket*, Bridgeport, Connecticut
Japanese *HA-8*, Groton, Connecticut
USS *Nautilus*, Groton, Connecticut
Italian *Siluro a Lenta Corsa*, Groton, Connecticut, USA
USS *X-1*, Groton, Connecticut
Auxilliary Schooner *Brilliant*, Mystic, Connecticut
USCGC *Eagle*, New London, Connecticut

Delaware

Lightship *Overfalls*, Lewes, Delaware

District Of Columbia

USS *Barry*, Washington, District of Columbia
LCVP, Washington, District of Columbia
Motor Whaleboat, Washington, District of Columbia
PCF-1, Washington, District of Columbia
RV *Trieste*, Washington, District of Columbia
Continental Gunboat *Philadelphia*, Washington, District of Columbia

Florida

PTF 3, Deland, Florida, USA
PBR Mark II, Orlando, Florida, USA
SS *American Victory*, Tampa, Florida

Georgia

CSS *Chattahoochee*, Columbus, Georgia
CSS *Jackson*, Columbus, Georgia

Hawaii

USS *Arizona*, Honolulu, Hawaii
USS *Bowfin*, Honolulu, Hawaii
Japanese *Kaiten*, Honolulu, Hawaii
USS *Missouri*, Honolulu, Hawaii
USS *Utah*, Honolulu, Hawaii

Illinois

German *U-505*, Chicago, Illinois

Indiana

USS *LST-325*, Evansville, Indiana

Iowa

USACOE Dredge *William M. Black*, Dubuque, Iowa

Louisiana

USS *Kidd*, Baton Rouge, Louisiana

Maryland

Lightship *Chesapeake*, Baltimore, Maryland
USS *Constellation*, Baltimore, Maryland
SS *John W. Brown*, Baltimore, Maryland
USCGC *Taney*, Baltimore, Maryland
USS *Torsk*, Baltimore, Maryland

Massachusetts

USS *Cassin Young*, Boston, Massachusetts
USS *Constitution*, Boston, Massachusetts
Tug *Luna*, Boston, Massachusetts
Demolition Boat, Fall River, Massachusetts
Hiddensee, Fall River, Massachusetts
USS *Joseph P. Kennedy, Jr*, Fall River, Massachusetts
LCM 56, Fall River, Massachusetts
USS *Lionfish*, Fall River, Massachusetts
USS *Massachusetts*, Fall River, Massachusetts
PT 617, Fall River, Massachusetts
PT 796, Fall River, Massachusetts
USS *Salem*, Quincy, Massachusetts
German *Seehund*, Quincy, Massachusetts

Michigan

USCGC *Bramble*, Port Huron, Michigan
SS *City Of Milwaukee*, Manistee, Michigan
USCGC *McLane*, Muskegon, Michigan
SS *Milwaukee Clipper*, Muskegon, Michigan
USS *Silversides*, Muskegon, Michigan

Mississippi

USS *Cairo*, Vicksburg, Mississippi

Missouri

USS *Aries*, Brunswick, Missouri

Nebraska

USS *Hazard*, Omaha, Nebraska
USS *Marlin*, Omaha, Nebraska

New Hampshire

USS *Albacore*, Portsmouth, New Hampshire

New Jersey

USS *New Jersey*, Camden, New Jersey
Japanese *Kaiten*, Hackensack, New Jersey
USS *Ling*, Hackensack, New Jersey
PBR Mark II, Hackensack, New Jersey
German *Seehund*, Hackensack, New Jersey
Fenian Ram, Paterson, New Jersey
Holland Boat #1, Paterson, New Jersey
Intelligent Whale, Sea Girt, New Jersey

New York

USS *Slater*, Albany, New York
USS *Croaker*, Buffalo, New York
USS *Little Rock*, Buffalo, New York
PTF 17, Buffalo, New York
USS *The Sullivans*, Buffalo, New York
MV *Commander*, Cornwall-on-Hudson, New York
USS *Growler*, New York, New York
USS *Intrepid*, New York, New York
USAT *LT-5*, Oswego, New York

Admiral's Barge, Romulus, New York

North Carolina

USS *North Carolina*, Wilmington, North Carolina

Ohio

USS *Cod*, Cleveland, Ohio
SS *William G. Mather*, Cleveland, Ohio

Oklahoma

USS *Batfish*, Muskogee, Oklahoma

Oregon

USS *Blueback*, Portland, Oregon
PT-658, Portland, Oregon

Pennsylvania

U.S. Brig *Niagara*, Erie, Pennsylvania
USS *Becuna*, Philadelphia, Pennsylvania
USS *Olympia*, Philadelphia, Pennsylvania
USS *Requin*, Pittsburgh, Pennsylvania

Rhode Island

Soviet *Juliett 484*, Providence, Rhode Island

South Carolina

USCGC *Ingham*, Mount Pleasant, South Carolina
USS *Laffey* Mount Pleasant, South Carolina
USS *Yorktown*, Mount Pleasant, South Carolina
USS *Clamagore*, Mount Pleasant, South Carolina
CSS *H. L. Hunley*, North Charleston, South Carolina

Texas

USS *Lexington*, Corpus Christi, Texas
Admiral's Barge, Fredericksburg, Texas
Japanese *HA-19*, Fredericksburg, Texas
PT 309, Fredericksburg, Texas
USS *Cavalla*, Galveston, Texas
USS *Stewart*, Galveston, Texas
USS *Texas*, LaPorte, Texas
USS *Orleck*, Orange, Texas

Virginia

USS *Monitor*, Newport News, Virginia
USS *Wisconsin*, Norfolk, Virginia
RV *Aluminaut*, Richmond, Virginia

Washington

USS *Turner Joy*, Bremerton, Washington
RV *Deep Quest*, Keyport, Washington
RV *Trieste II*, Keyport, Washington
Tug *Arthur Foss*, Seattle, Washington
Lightship *Swiftsure*, Seattle, Washington
Schooner *Wawona*, Seattle, Washington

Wisconsin

USS *Cobia*, Manitowoc, Wisconsin
USCG Boat *Icelander*, Manitowoc, Wisconsin

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